AMBITION: What has been done so far?

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NeuroCIMT #7 Project Goals

Develop and evaluate an on-body sensing and real-time biofeedback system for optimal, patient-tailored motor rehabilitation in neurological disorders, aimed at understanding neural repair and compensation in motor performance of upper and lower extremities during daily life.

- Restitution vs. Substitution
  Understanding differences between true neurological repair and appearance of alternate/ compensatory patterns
- Ambulatory Sensing in ADL
  Feasibility of wearables in measuring quality of movement in ADL
- Biofeedback Modalities
  Identifying intelligent feedback and feedback modalities to improve quality of motor function

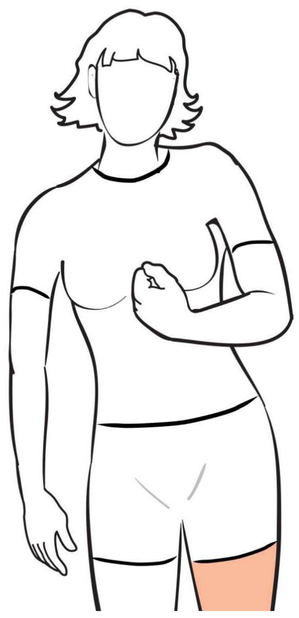
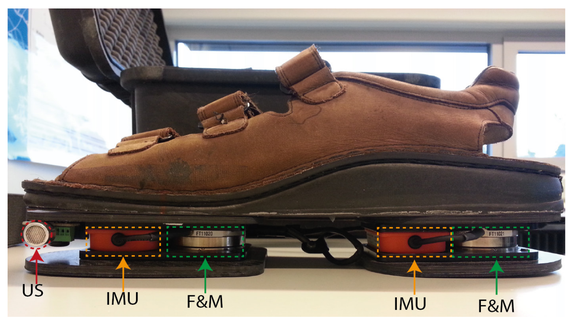


Fig 1: Compensatory movement strategies exhibited by hemiplegic subjects

Questions asked..

Q1: **Feasibility of using pressure insoles over force sensors as a wearable setup for measuring gait & balance.**



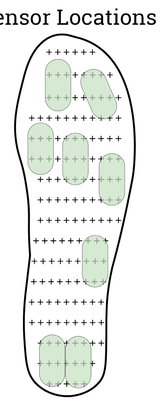


Fig 2: Experimental Setup of ForceShoe and Pressure sensors

Take Away:

- 1D Pressure as replacement for 3D forces and moments
- Contribution of foot kinematics and kinetics towards CoM/XCoM estimations
- Influence of high/low frequency CoM information on stability margins
- Estimating XCoM without any kinetics

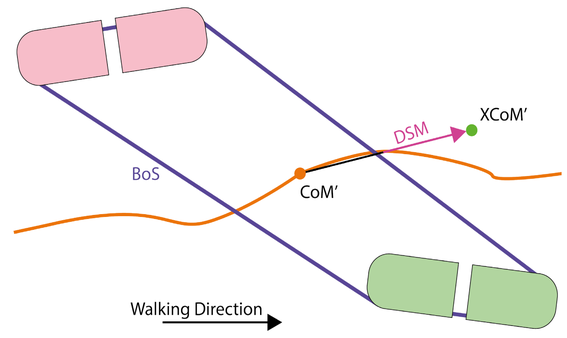


Fig 3: Graphical definitions of stability parameters

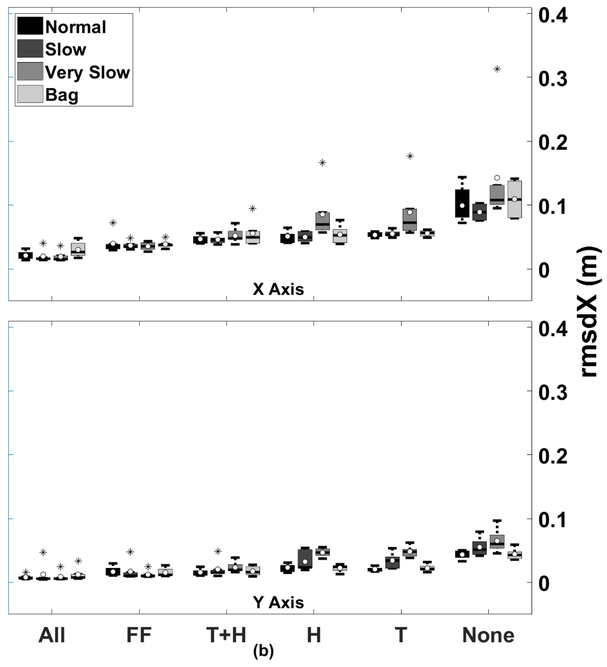


Fig 5: Comparisons of XCoM estimated using ForceShoe and Subject Specific Models for different walking tasks

Questions asked..

Q2: **Influence of walking speed and casting on dynamic margins of stability (DMoS).**

Take Away:

- Subjects reduced their step lengths when casted, when walking at moderate and fast speeds.
- DMoS in AP direction increases when walking speed increases, as XCoM falls further outside BoS.
- DMoS increases in ML direction when walking speed increases, but only true for slow and fast speeds when casted.
- DMoS is thus sensitive to walking speed and asymmetrical walking.
- Study also shows compensation strategies of healthy subjects towards induced asymmetry.

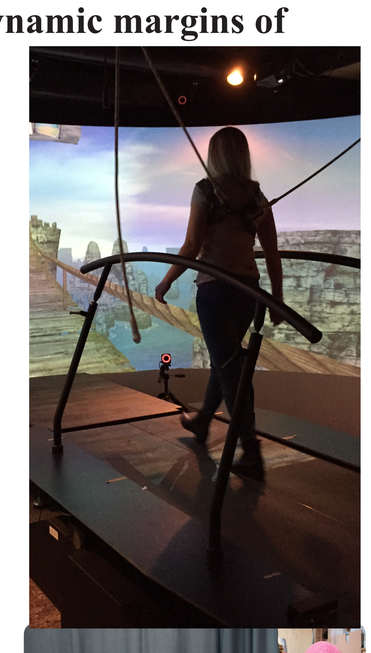
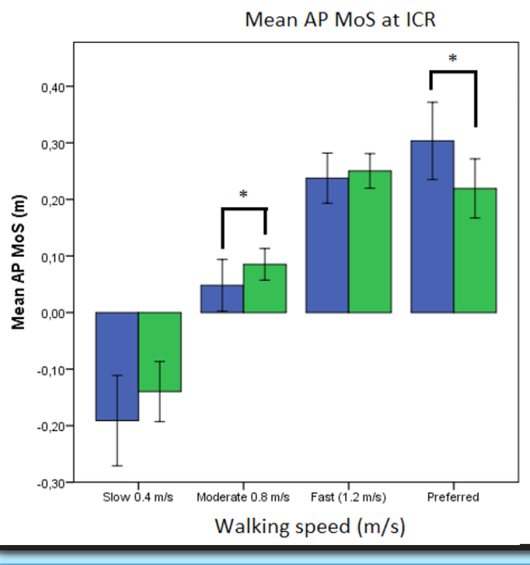
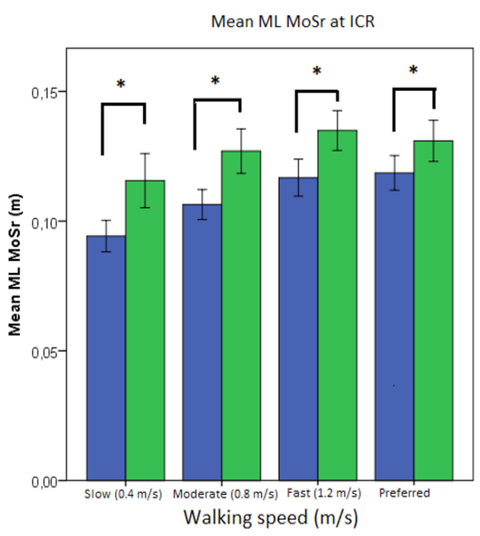


Fig 6: GRAIL lab and a casted foot





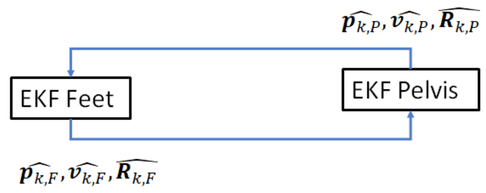
Current and Future Studies

Q3: **How are movement related body functions measured by kine(ma)tic metrics in stroke subjects during a reach and grasp task?**

- Systematic Literature Review
- Reaching as a functional task
- Assessing reliable, valid, and responsive upper limb kinematics measurable by an ambulant setup
- Registration of review: PROSPERO CRD42018100648
- Completion of full TIAB screening
- Full text screening underway
- Stroke Rehabilitation and Recovery Round Table

Q4: **Feasibility of an IMU (pelvis & feet) only approach, for ambulatory estimation of stability**.

- IMU based approach
  * Kinematics
  * Forces
  * Relative distance estimations
- Foot IMUs
  * Foot kinematics
- Pelvis IMU
  * CoM oscillations
  * Body kinetics



Future Studies:

- Studies on Stroke subjects
- Ambulatory UE sensing during ADL
  * Minimal and contextual sensing
- Biofeedback Modalities
  * Quality of motor function
  * Feedback Modalities

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