## Semester / Bachelor / Master thesis

## *"The biomechanics of human body during balance on a wobble board and gait perturbed"* (70% experimental, 30% theoretical)

**Project background**

Maintaining joint stability and balance during dynamic activities is essential for human movement. Despite its importance, existing datasets often lack comprehensive integration of electromyography (EMG), ground reaction forces (GRF), and motion capture data (MoCap), limiting the accuracy of biomechanical models.

This thesis focuses on collecting a high-quality multimodal dataset that captures muscle co-contraction dynamics during balancing on a wobble board and under controlled gait perturbations. The dataset will serve as a foundation for future research, including machine learning models for predicting neuromuscular responses.

**Research objectives**

The main goal of this thesis is to use the *ethically approved* experimental protocol and collect a dataset that integrates:

- EMG: measuring muscle activation of key agonist-antagonist pairs.
- MoCap: tracking whole-body kinematics.
- GRF: capturing the external forces acting on the body using force plates.
- Perturbation metrics: systematically applying controlled gait disturbances (e.g., speed changes, lateral shifts, inclination adjustments).

**Methodology**

- Literature review: study state-of-the-art methods in balancing on a balance board, gait perturbation and muscle co-contraction analysis.
- Participants recruitment
- Data collection: preparing the participants for performing the protocol ensuring safety and consistency.
- Data analysis: ***to be defined together with the student***.

**Expected outcomes**

- A well-structured multimodal dataset of balancing on a wobble board and walking under perturbations.
- Analysis targets: ***to be defined together with the student***.

**Requirements**

- Strong interest in experimental research.
- Background in mechanics, biomechanics, sports science, biomedical engineering, or a related field.
- Experience with EMG, motion capture, or force plate data collection is a plus.
- Basic knowledge of signal processing, Python, OpenSim or machine learning is a plus.

**We offer**

- Access to the Rehabilitation Robotics Lab of MIRMI, TUM.
- Supervision and support from leading researchers in gait analysis.
- Hands-on experience with cutting-edge motion analysis technologies.
- Potential to contribute to high-impact scientific publications.

**Application**

Interested candidates should submit:

1. A CV (max. 2 pages).
2. Transcript of records.

For questions, please email Gheorghe Lisca at: gheorghe.lisca@tum.de