University of Basel

Department of
Biomedical Engineering

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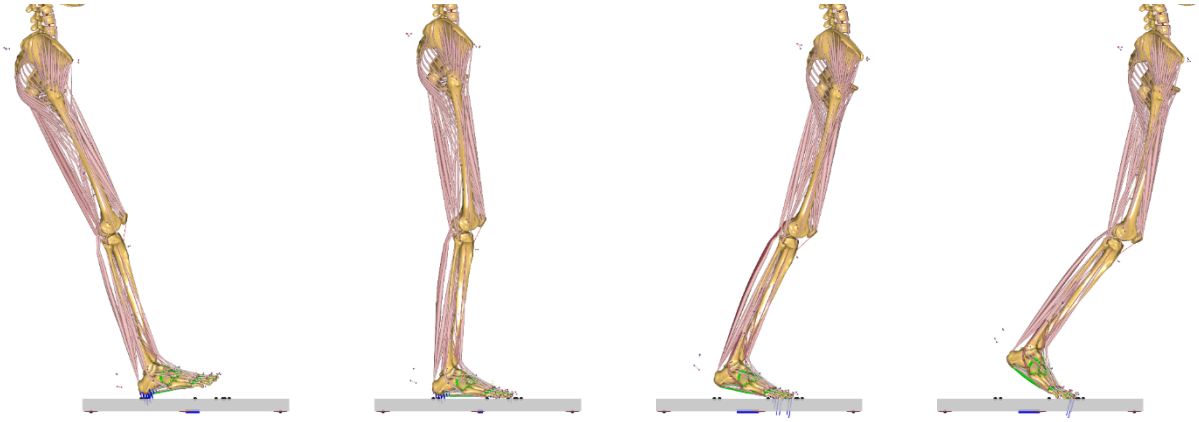
Master of Science – Biomedical Engineering
Thesis Proposal

Master Thesis Title

Predicting foot kinetics during walking in children with cerebral palsy



Clinical applications of markerless motion tracking are dependent on understanding the forces applied to the human body. The aim of this project is to further advance current musculoskeletal models for predicting ground reaction forces in a cohort of paediatric patients with cerebral palsy who present altered foot-ground contact patterns.

Walking is the most common and necessary form of movement for humans, as it ensures active participation in activities of daily life. Children that suffer from neuro-developmental disorders (e.g. cerebral palsy, CP) are often not able to heel-strike, they tend to keep walking with a forefoot or flatfoot pattern (i.e. toe-walking). Children that toe-walk often show poorer levels stability, leading to a lower quality of life compared to typically developing children. Different treatment strategies are available to restore a functional motor capability in these patients, however choosing the best treatment option for each patient requires a thorough evaluation of the patient's walking pattern, which is normally performed through 3D gait analysis in a motion-capture laboratory.

At the University of Basel Children's Hospital (UKBB), over 200 paediatric patients each year undergo conventional gait analysis as part of their clinical assessment.

Motion-capture laboratories are normally equipped with advanced camera tracking system and force plates, which provide information about lower-limb kinematics and the dynamic interaction between foot and the ground (ground reaction forces, GRFs). Advancements in markerless motion tracking technologies are opening up opportunities to expand motion analysis beyond the boundaries of a confined laboratory-space, however the use of these technologies for clinical purposes is limited as they do not provide any information regarding the dynamics of walking, such as joint moments and intra-articular forces.

The use of musculoskeletal modelling can overcome such limitation. Musculoskeletal modelling is currently gaining relevance in a broad range of scientific, clinical, and industry-related applications.

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Software like Anybody Modelling System allows to calculate internal muscle activations and joint intra-articular forces during gait through inverse dynamics analysis, as well as to predict foot-ground interactions and GRFs.

The aim of this project is to further advance current musculoskeletal models for predicting GRFs in a cohort of paediatric CP patients who present altered foot-ground contact patterns, and to validate these prediction with existing force-plates measurements.

The student will learn the basics of musculoskeletal modelling, including the principles of inverse dynamics based on motion capture data, and understand how this knowledge can be applied within an established clinical setting.

Nature of the Thesis

Experimental: (possible to participate in motion capture data collection at the hospital when interested)
Programming: 70%
Documentation: 30%

Specific Requirements

Basis knowledge of MatLab or Python is required

Supervisor

Dr. Enrico De Pieri
Rosa Visscher (ETH Zurich)
Prof. Dr. Heide Elke Viehweger (UKBB)

Collaborators

The project is a collaboration between the Laboratory for Movement Analysis of the Neuro-Orthopaedics department of the University of Basel Children's Hospital (UKBB) and the Laboratory for Movement Biomechanics at ETH Zurich.

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