University of Basel

Department of
Biomedical Engineering

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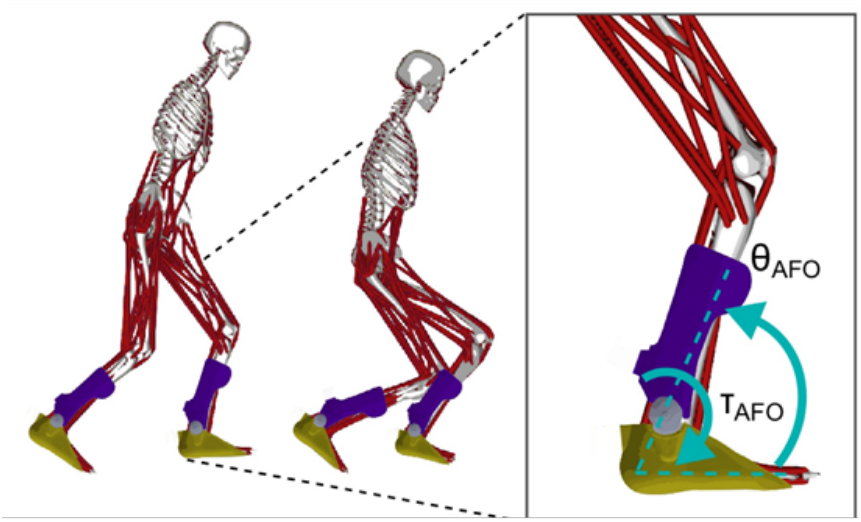
Master of Science – Biomedical Engineering
Thesis Proposal

Master Thesis Title

Understanding the effect of ankle foot orthoses on muscles' energetic demand in children with cerebral palsy



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Ankle foot orthoses represent an important treatment option for children with cerebral palsy. The aim of this project is to develop a customizable mechanical model of an AFO within an existing musculoskeletal modelling framework, and to apply it in a cohort of paediatric CP patients to evaluate their gait pattern and the muscles' energetic demand.

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 with CP undergo conventional gait analysis as part of their clinical assessment each year.

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Ankle foot orthoses (AFO) come in several form and designs. Their function is to generate an assistive torque around the ankle joint, which helps preventing the child from dropping his/her foot during swing phase and therefore ensures a better foot placement during weight acceptance and provides a better sense of stability. AFOs can be customized to the child's individual needs, however a thorough understanding of the mechanical effect of the orthosis during gait, and particular on the muscles' energetic demand,is still missing.

Musculoskeletal modelling, through commercially available software such as the Anybody Modelling System, allows to calculate the required muscle activations and joint forces and moments during walking. These tools are currently gaining relevance in a broad range of scientific, clinical, and industry-related applications and they represent a suitable tool to better characterize the effective of these orthoses in terms of muscles' energy demand.

The aim of this project is to develop a customizable mechanical model of an AFO within an existing musculoskeletal modelling framework. This model will then be applied in a cohort of paediatric CP patients to assess if AFOs effectively improve their gait pattern and the muscles' energetic demand.

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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