Optimization and Biomechanics for Human Centred Robotics
KIT BioRobotics Lab

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Master's Thesis: Modeling human-exoskeleton interaction for the Wandercraft Atalante X: evaluating the compliance in interfaces

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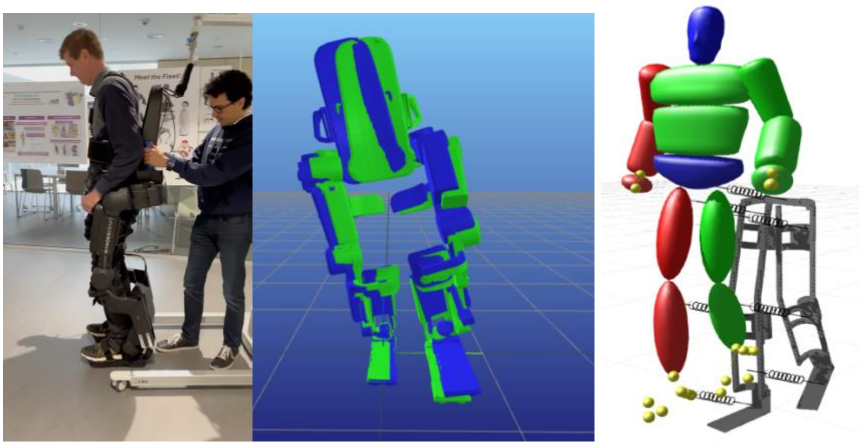
Background

Exoskeletons, also called wearable robots, for medical applications have undergone rapid development in recent years, with many new research prototypes as well as commercially available models for different areas of the body and different types of impairments. In all cases, the aim is to provide the best possible support for the individual user and their specific requirements which is very challenging due to the complexity of the combined human-exoskeleton system. Computer models of human-exoskeleton interaction which can be used in simulation, optimization and learning play an important role in exploring control approaches and improving exoskeleton technology.



Scope of the thesis

The objective of this Master's thesis is to develop a full combined human-exoskeleton model for the lower limb self-balancing exoskeleton Wandercraft Atalante X [1] which we recently received in our lab. Based on existing simpler lumped-mass models of Atalante and our previous work on human-exoskeleton modeling we would like to set up a model that covers the full dynamics of the exoskeleton and of all relevant segments of the human. A special focus is on modeling the interfaces which couple the exoskeleton to the human and which can be described as compliant elements for which parameters need to be identified. The tasks of this thesis include:

- Formulating the coupled human-exoskeleton model
- Developing procedures for adjusting & personalizing the model
- Performing experiments with the Atalante to record human-exoskeleton motions during different tasks including relative motions at the interfaces
- Formulating a least-squares optimization problem to reconstruct the motions and identify spring constants for the coupling elements

Required knowledge

This thesis requires understanding of mechanical and robotics concepts (Robotics 1 or similar), knowledge on modeling, simulation & optimization (e.g. lecture Simulation & Optimization in Robotics & Biomehanics), programming knowledge.

[1] Wandercraft Atalante X, https://en.wandercraft.eu