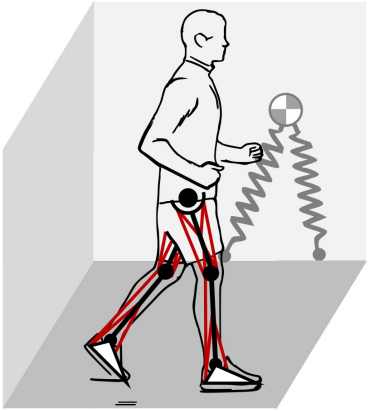
Review and Predictive Control of Conceptual Bipedal Walking Models

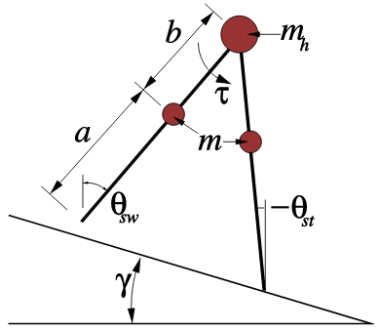
TECHNISCHE UNIVERSITÄT DARMSTADT

Project Seminar

Motivation: Accurate models of human and robotic gait are comprised of complex, high-dimensional, and nonlinear dynamics, leading to increased computational effort during simulation and control. As a remedy, simpler conceptual models for bipedal walking were introduced in the literature. These models capture the fundamental principles and mechanisms of gait on different levels of abstraction and for different scenarios, thus providing insight into the dynamics of bipedal walking while maintaining computational tractability.



Additionally, conceptual models can be exploited for the prediction of walking behavior. This is especially useful for optimization-based control approaches such as model predictive control (MPC), which is based on repeated model-based prediction and optimization towards a desired reference. In this project, you will explore the suitability of conceptual models for reference trajectory generation as well as closed-loop control based on MPC.



Your **Tasks** will be:

1. To review the literature on conceptual walking models and select at least two different models.
2. To discuss and compare these models theoretically as well as in simulation and compare the resulting gait patterns to human gait.
3. To implement a model predictive controller for the conceptual models in Python and compare it to a classical control scheme.

Prerequisites: Experience with modeling and control of dynamical systems (required), model predictive control (beneficial).

Programming: Python (good to very good skills).

Languages: English or German (discussions, writing, presentation).

Andreas Höhl M.Sc.
Room: S3|10 521
E-Mail: andreas.hoehl@iat.tu-darmstadt.de

Sebastian Hirt M.Sc.
Room: S3|10 510
E-Mail: sebastian.hirt@iat.tu-darmstadt.de

CCPS Control and Cyber-Physical Systems