Universität Stuttgart

Institut für Nichtlineare Mechanik

Masterarbeit

Identifying Optimal Gaits for the Quadrupedal Robot RAM*bi*

The goal of this project is to use optimal control to generate energy optimal motions for the quadrupedal robot RAM*bi*. Quadrupedal gaits, such as walking, trotting, or galloping, are primarily defined by their footfall sequence. That is, by the order in which the feet strike and leave the ground. In this project, we want to investigate how this sequence influences the energetic cost of locomotion. In particular, we would like to understand, how the mechanical properties of the robot aide with locomotion while using different gaits. RAM*bi* is a quadrupedal legged robot that is specifically built for this task. It can exhibit a rich set of dynamical motions and contains springs in its actuators that can temporarily store and return elastic energy, similar to muscles and tendons in humans and animals.

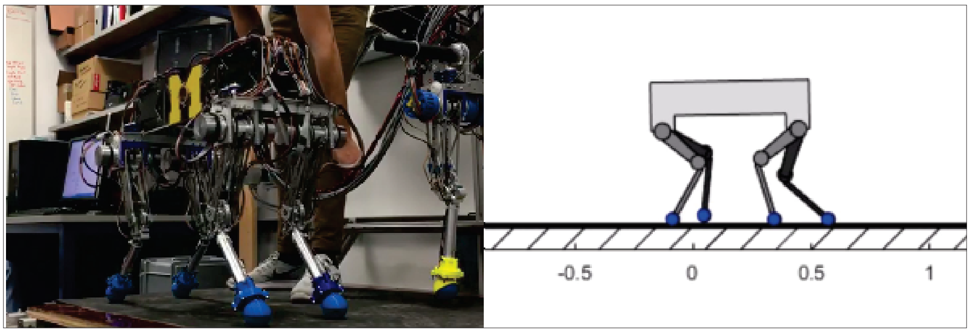

Abbildung 1: The work will be performed on the quadrupedal robot RAM*bi*.

Your task in this project is to determine which exact motions will minimize energy usage and will best exploit the mechanical dynamics and elastic energy storage. We seek to determine this in simulation, by using optimal control on a realistic model of the robot. That is, you will first identify and validate a dynamic model of the robot that will be implemented as a set of nonlinear differential equations. The motion will be encoded as discretized trajectories and actuator inputs that will then be optimized to minimize energy expenditure during locomotion. To this end, you will investigate a variety of algorithms, including multiple shooting and direct collocation approaches.
The project will be conducted in collaboration with the Robotics and Motion Laboratory at the University of Michigan (`http://ram-lab.engin.umich.edu/`). The RAM*bi* robot is located in this lab and it is expected that you will spend part of your time on-site in Ann Arbor, Michigan to identify your model. A stipend will cover the costs of your flight.

Themengebiete:	Nonlinear Dynamics, Limit Cycles, Bifurcations
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