

Universität Stuttgart

Institute for Adaptive Mechanical Systems

Bachelor's thesis
Term paper
Master's thesis

Sensing the deformation of a compliant robotic leg

Subject: Controls, State estimation,
Legged robotics

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Responsible Professor: Prof. Dr. Remy

Prior knowledge (ideally): Dynamics of mechanical systems,
Dynamics & Control,
Experience working on hardware

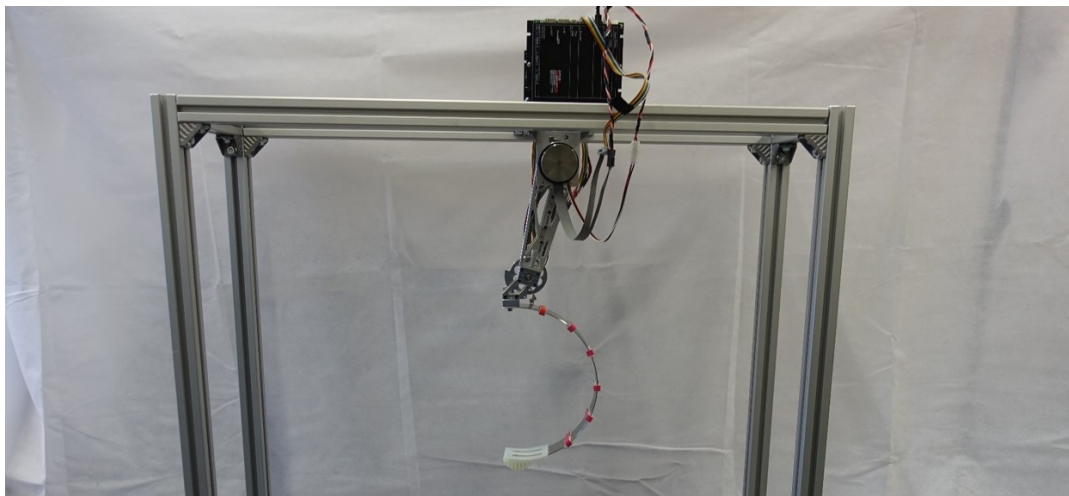
The Institute of Nonlinear Mechanics is working towards a new generation of legged robotic systems; –robots with continuously deformable elements integrated into the mechanical structure of their legs.

The goal of this project is to reliably measure the deformation of such continuously deformable legs. To overcome the challenge, that continuously deformable structures are characterised by an infinite amount of degrees of freedom, a finite representation of the compliance will be chosen. Based on this representation, measurement possibilities and observability criteria will be analysed. In addition you will need to select and integrate suitable sensors into the existing hardware of our robot, develop a custom-built al-

gorithm to fuse the sensor readings into a robust estimate of the leg's deformation, and test your implementation in hardware.

Specifically, you will:

- derive and implement a Hencky-type beam formulation of a deformable leg
- theoretically analyse observability and determine the optimal placement of sensors
- compare and evaluate sensor hardware, select a specific sensor type, and implement your solution on a test-bench
- derive and implement algorithms for signal processing and sensor fusion
- experimentally compare your results with ground truth measurements



This project develops sensing capabilities for a robot with continuously deformable legs