

University of Stuttgart

Institute for Nonlinear Mechanics

Bachelor's thesis

State
Estimation
for a Planar
Monoped

Topic Areas: Control, State Estimation,
Legged Robotics

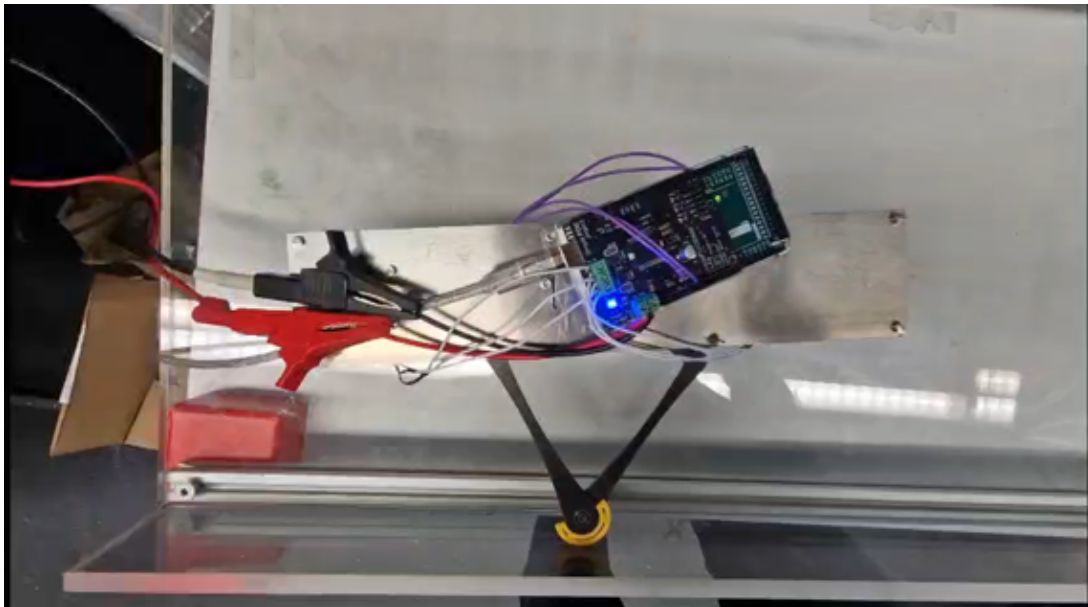
Advisors: Maximilian Raff,
raff@inm.uni-stuttgart.de

Responsible Professor: Prof. C. David Remy

Prerequisites/Prior Knowledge: Mechanical Engineering, Matlab

The project aims to precisely estimate the states of a monoped constrained to an inclined slope. Utilizing data from the IMU and encoder sensors mounted on the robot, the task involves adapting and implementing established methodologies from literature, primarily focusing on the extended Kalman filter. A notable challenge lies in the hybrid nature of the system, wherein the foot intermittently breaks and makes contact with the ground.

Your work begins with thorough modeling of the monoped's dynamics, incorporating experimental evaluations to determine system parameters such as inertias, geometry, and measurement noise. Following this, you will implement the model in Matlab and conduct a thorough literature review to identify suitable observer designs. Subsequently, you will proceed to test various state estimators through simulation before transitioning to hardware.



Planar Monoped

- [1] Bloesch, Michael, et al. *State estimation for legged robots-consistent fusion of leg kinematics and IMU*. Robotics 17 (2013): 17-24.
- [2] Dhédin, Victor, et al. *Visual-inertial and leg odometry fusion for dynamic locomotion*. 2023 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2023.