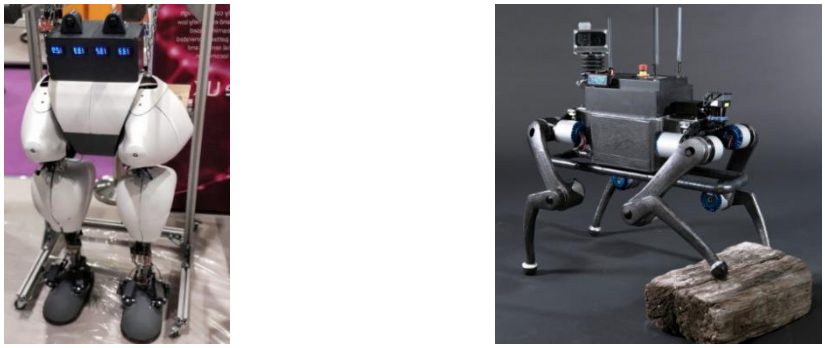
Delft Center for Systems and Control

Master Graduation Project

Learning Hybrid Dynamical Systems for Model Predictive Control

Project Description

Many engineering systems contain both continuous and discrete dynamic behavior, e.g., the evolution of continuous dynamics and the switching among different operating modes. Examples of these so-called hybrid systems include legged robots, traffic networks, power grids, and energy systems in buildings. To control these hybrid systems, Model Predictive Control (MPC) is a widely applied control strategy. The successful application of MPC typically requires a good prediction model of the hybrid system; however, creating a physics-based model is often challenging and time-consuming. In addition, due to the discrete behavior of the hybrid systems, the resulting MPC controllers are typically computationally expensive and thus not suitable for real-time implementation.



Examples of hybrid systems that can be controlled by MPC controllers: bipedal robots (left, Kouppas et al., Rob Auton Syst, 2021] and quadruped robots (right, ANYmal developed by ETH Zurich)

In this master graduation project, the focus is on the development of a new learning algorithm for the data-driven modeling of hybrid dynamical systems. The algorithm will be particularly designed such that the learned hybrid system model can be used for designing computationally-efficient MPC controllers. The resulting MPC controller will be validated in simulation case studies in the field of legged robotics.

Project Application

Experiences in the following aspects are preferred but not strictly required:

1. Data-driven modeling, e.g., system identification, machine learning, or signal processing
2. Systems and control: Hybrid systems, model predictive control

Contact

This project will be conducted in the research group of Prof. Bart De Schutter. If you are interested in this project, please contact me via the following email:

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