TECHNISCHE UNIVERSITÄT MÜNCHEN
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M A S T E R ' S T H E S I S
for
You
Student ID 0123456789, Degree MSEI

Learning-based control: Safe nonstochastic control for uncertain systems

Problem description:

Classical robust and optimal control are the foundation of modern control theory. However, if systems and environments and optimal behavior are partially unknown, these frameworks reach their limit. In online nonstochastic control, both the cost functions as well as the perturbations from the assumed dynamical model are unknwon, possibly chosen by an adversary. The optimal policy is thus not defined a priori. Rather, the target is to attain low regret against the best policy (from a similiar class) that could have been applied in hindsight [3]. While interesting results on optimality have been established in literature, safety in the sense of guaranteed satisfaction of state constraints is still an open problem, especially if the system is (partially) unknown and disturbances are present [2]. Novel results in the linear data-driven control literature (see for example [1]) may alleviate the problem of dealing with unknown disturbed systems: From input, state data alone, a collection of system matrices that could explain the data may be inferred. The goal of this master thesis is to include this result into a state of the art nonstochastic control framework, and use it to develop a controller that allows for safe and regret-optimal control of unknown linear systems in the face of adversial disturbances.

Tasks:

- Literature research on data-driven predictive control from noisy data.
- Development of a tube based predictive controller that accepts noisy data.
- Investigation of the effect of noise in the available data on control performance.
- Investigation of closed loop properties such as recursive feasibility.
- Evaluation in a simulation example in MATLAB.

Bibliography:

[1] Amr Alanwar, Anne Koch, Frank Allgwer, and Karl Henrik Johansson. Data-driven reachability analysis from noisy data. *IEEE Transactions on Automatic Control*, 68(5):3054–3069, 2023.
[2] Elad Hazan, Sham Kakade, and Karan Singh. The nonstochastic control problem. *Proceedings of the 31st International Conference on Algorithmic Learning Theory*, 117:408–421, 2020.
[3] Elad Hazan and Karan Singh. Introduction to online nonstochastic control, 2023.

Supervisor:	M.Sc. Sebastian Kerz
Start:	X
Intermediate Report:	XX
Delivery:	XXX

(D. Wollherr)
Priv.-Doz.