Direct Data-driven Approach for System Analysis and Control

TECHNISCHE UNIVERSITÄT DARMSTADT

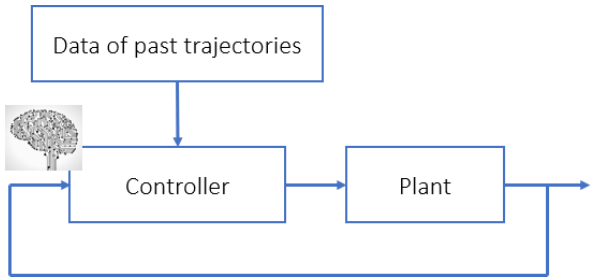
Proposal for a Master's Thesis Project

There has been an increasing attention on system analysis and controller design methods based on data (data-driven approach) instead of the model-based methods in recent years. However, not many of them can provide rigorous guarantees.

It is shown in [1] that the whole set of trajectories which a linear system can generate can be represented by a finite set of its past trajectories, if such past trajectories come from sufficiently excited dynamics. Therefore, instead of requiring a prior identification step, we can directly use the data measured from the past trajectories to design the controller for the system. There are several works following this idea, which have been proposed in [2], as well as attempts to extend the framework to the case of nonlinear systems.

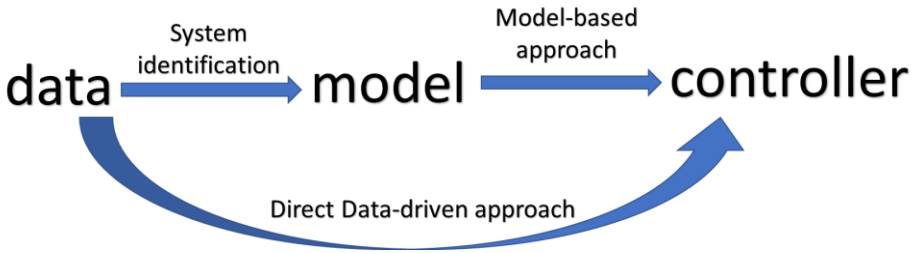
This research aims at developing model-free system analysis and control methods, which are only based on measured data.

The project is mainly theoretical and done in simulation. The student should also be familiar with Matlab. The language for discussion and writing is preferably English. For more information and further discussion, you are welcome to contact me via email.



[1] Jan C. Willems, Paolo Rapisarda, Ivan Markovsky, Bart L.M. De Moor, "A note on persistency of excitation," Systems & Control Letters, vol. 54, no 4, pp. 325-329, 2005.

[2] C. De Persis and P. Tesi, "Formulas for Data-Driven Control: Stabilization, Optimality, and Robustness," in IEEE Trans. Automat. Cont, vol. 65, no. 3, pp. 909-924, 2020.



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CCPS Control and Cyber-Physical Systems