technische universität dortmund

Process Dynamics and Operations

Diplomarbeit / Masterarbeit

Integration of active learning in model predictive control

Introduction:

The development of suitable first-principle models for model-based applications (e.g. model predictive control) often is bottleneck. This is due to the high costs of the development and/or the complexity of the process to be modelled. In such cases, data-based modelling (especially, modern machine learning methods) offer a countermeasure in which a process is modelled based on available input-output data.
However, (chemical) processes change over time (concept drift, e.g. catalyst degradation, changes in raw material, revamp of the plant, …) resulting in a degradation of the quality of an employed model. Therefore, the online model monitoring and (when necessary) adaptation based on available measurements (data streams) plays an important role in the online application of machine learning models in control.
In this thesis, modern methods in the field of online learning and drift detection (e.g. ensemble methods) shall be investigated and be applied in simulation studies to improve the performance of a Nonlinear Model Predictive Controller (NMPC).

Milestones / scope of the work:

a) Literature review
b) Investigation of online learning methods for monitoring and adaptation
c) Implementation/Investigation of a suitable algorithm
d) Integration into the do-mpc framework
e) Application to a case-study from the literature

Prerequisites:

- Interest in programming, control and machine learning
- Python\Matlab preferable

Begin and duration:

Now, 6 month full time

Literature:

1. Loeffel, P. (2018). *Adaptive machine learning algorithms for data streams subject to concept drifts*.
2. Krawczyk, B., Minku, L. L., Gama, J., Stefanowski, J., & Woźniak, M. (2017*). Ensemble learning for data stream analysis: A survey*.
3. Schoukens, J., & Ljung, L. (2019). *Nonlinear System Identification: A User-Oriented Road Map*
4. Lucia S., Tatulea-Codrean A., Schoppmeyer C., Engell S. (2017) *Rapid development of modular and sustainable nonlinear model predictive control solutions.*

Contact:

Jens Ehlhardt, Tel.: 0231 / 755-5124, G2-5.10, jens.ehlhardt@tu-dortmund.de

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