Methods for Data-driven Model Predictive Control

Application to intelligent building control

Achin Jain, Truong X. Nghiem, Manfred Morari, and Rahul Mangharam

POC: A. Jain (achinj@seas.upenn.edu)

May 20, 2019

- physics-based modeling not suitable in applications like building control
- need for cost reduction in order to deploy MPC at scale
- this work explores the use of machine learning based models
- how is machine learning used in a traditional sense?
- what are the requirements for predictive control?
  - predictive dynamical model
  - performance guarantees for control
- outline of the work
  - economic MPC
  - what we don't do

Inversion of machine learning models for control

- challenges with constrained optimization using ML models
- hard because of non-convexities, non-differentiabilities, non-closed form solution, give examples with trees, forests, Gaussian processes, neural networks
- cannot use RL, we want model-based
- traditionally optimization in ML unconstrained
- for control we need constrained optimization
- examples of different applications building will be main focus

Application – building control and demand response

- intro to building control and demand response
- need for model predictive control
  - energy efficiency, energy flexibility $- >$ energy savings, cost savings
- so we need models, why is traditional way of modeling hard
  - model capture using historical data

- change in material properties
- model heterogeneity

- Practical challenges
  - quality of historical data, need for new experiments, sensor failure
  - computational complexity of control/optimization algorithms, real-time control
  - performance guarantees and robustness
  - model adaptability
  - indicator for deterioration, when to update, use statistics of error in prediction
- A concrete example that describes the modeling and control problem
  - description of building: different types of buildings like RTU, central heating/cooling, impact of thermal inertia
  - goals for modeling types of models to be identified
  - goals for control cost minimization, energy minimization, thermal comfort bounds

Conclusion

Example of Sidebar

References

[S1] Random reference number one generated for a sidebar, 2016
[S2] Random reference number two generated for a sidebar, 2016

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Author Biography

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