ABSTRACT

Data-Driven Model Predictive Control for Time-Varying Uncertainty

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Multistage model predictive control (MPC) represents uncertainty via enumeration of scenarios that represent various realizations of the uncertainty. Since the choice of these scenarios determines the degree of conservativeness of the solution, it is important to choose them wisely. We propose a dynamic, data-driven approach based on principle component analysis (PCA) to select these scenarios. PCA is effective in capturing the underlying hidden correlation between the uncertain parameters, thus leading to selection of those scenarios that explain the uncertainty distribution better. The PCA is performed online within the MPC framework to select new scenarios whenever uncertainty information is updated. The methodology is applied to a thermal storage system with one energy supplier and one energy consumer. The uncertainties are considered in the temperatures at which the supplier and consumer supply/extract heat from a thermal storage tank. The objective is to operate the tank optimally such that the consumer satisfies most of its energy demand via the thermal storage tank and expensive energy purchase from the market is minimized. The obtained solution is less conservative than with a nominal MPC approach, since the latest uncertainty information is captured via the data-driven approach.

References:

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