

Adaptive Predictive Control for Smart Energy Systems

PhD Thesis in IETR\Automatic Team

Keywords : Model Predictive Control, learning-based technics, Smart Energy Systems

Localisation : CentraleSupélec, Rennes campus

Resume

The project addresses the development of adaptive model predictive techniques in smart energy systems.

Background and Project Description

Energy is the critical sector affecting the quality of life worldwide. Nowadays, vast concerns of sustainability, climate change, and carbon emission motivate multiple research initiatives on the energy management front. Due to the increasing penetration level and production share of renewable sources, energy management becomes more sensitive to inevitable variations of the environment, such as weather conditions. For efficient operation, these systems must be flexible; they must react and adapt to changes in operating, such as whether or daily energy consumption patterns.

The model predictive control (MPC) is a widely used control strategy in energy management. MPC can handle multiple complex objectives, ensuring constraints satisfaction and performance optimality. However, MPC depends on the used model, and the overall performance is sensitive to model imperfections and variations. The need to alleviate this sensitivity and make predictive control more flexible and reactive gave rise to the concept of adaptive predictive control with data-driven parameter learning. This concept allows the control strategy to learn the model and adapt to environment variations.

An open question in adaptive MPC is the performance during the learning phase. The main concerns are the control optimality during the model update and our ability to reconstruct an accurate model from observations; the latter is related to the safety of the closed-loop regulation with the learning incorporation.

This project aims to address these issues and develop predictive control with empowered learning performance answering the questions discussed above.

LAB/Team/Supervisor

The project will be held in the Automatic team of CentraleSupélec (Rennes, France) under the supervision of Stanislav Aranovskiy and Romain Bourdais.

The Automatic Control team of the IETR lab (<https://www.ietr.fr/en/aut-automatic-control-team>) develops control strategies with a strong application focus on energy systems: distribution networks, smart buildings, smart-grid, and isolated networks. All the team members are also teaching at the Rennes campus of CentraleSupélec around the specialization "Sustainable Systems and Energy." They thus have an excellent knowledge of the current issues and challenges of industrialists regarding the

problems of implementing the energy transition (more than a dozen industrial contracts over the past five years).

The lab is also involved in various intellectual societies and has solid scientific cooperation with various international laboratories.

Requirements

The successful candidate is expected to have a Master or equivalent degree in the field of Control Theory, preferably with experience in Optimal, Predictive, or Adaptive control. Good oral/writing skills in English are required.

To apply

Send an email to Romain Bourdais (romain.bourdais@centralesupelec.fr) and Stanislav Aranovskiy (stanislav.aranovskiy@centralesupelec.fr) with a motivation letter, a short CV, and a transcript of academic records. Only appropriate and complete applications will be considered.