hybr2d Theory of Hybrid Systems Informatik 2 | RWTH AACHEN UNIVERSITY

Bachelor / Master Thesis

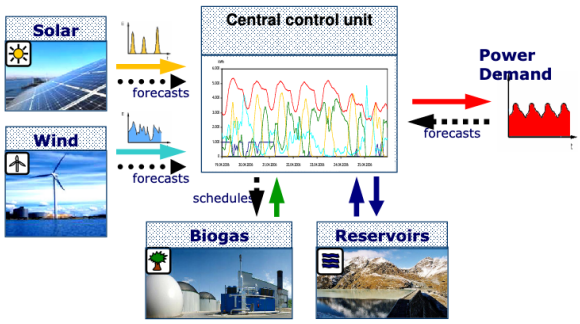
Smart City – Optimal Design of Virtual Renewable Power Plants with Storage

Course of study: Mathematics, Computer Science, Computational Engineering
Kind of thesis: Programming, Simulation, and Optimization
Programming language: Python
Start: April 2020

Topic

In recent years, environmentally friendly power production has become increasingly important. Methods to generate renewable energy are being developed rapidly and is soon a viable competitor to fossil fuel. Integrating intermittent renewable energy such as wind energy in power systems has therefore been more and more important. Such hybrid power systems are challenging to control, especially when the grid size is limited, due to stochastic quantities such as consumed power and produced power. Model Predictive Control based on mixed integer nonlinear programming has been proposed as a suitable methodology.

In this project we are looking at a hybrid energy power plant, which optimally combines the advantages of various energy sources. Within two case studies the cost-optimal configuration for a Smart City or a solar thermal - photovoltaic (CSP-PV) hybrid power plant is investigated.



The focus of this thesis is on the application of Adaptive MPC using MINLP.

Preliminary work

Simulation models for all subsystems exist already.

Tasks

The following tasks have to be solved:

- Check the models for the chosen subsystems (photovoltaic power, solar power, wind energy, hydro power, and storage as thermal storage, bio gas or power to X) by considering meteo data[1].
- Literature research on hybrid renewable energy power plants and the application of Adaptive MPC with a focus on Hybrid Power systems. Brief overview over some chosen MINLP concepts and techniques.
- Implement a standard controller strategy (e.g. buffer strategy) as baseline.
- Implement a model predictive controller using Pontryagin's maximum principle and shooting method.
- Case study. Illustrate the performance and compare the control strategies.
- Find optimal configuration for storage size and sizes of other subsystems, regarding investment costs and revenue.

[1] Solar irradiation (GHI), wind speed and wind direction.

Contact This project is offered by the *Theory of Hybrid Systems* (i2) research group headed by Prof. Dr. Erika Ábrahám. The project will be co-supervised by Dr. rer. nat. Pascal Richter. For further questions please contact us via email:

Dr. rer. nat. **Pascal Richter**
Theory of Hybrid Systems (i2)

Ahornstr. 55
+49 241 80 21244
pascal.richter@rwth-aachen.de