



Model predictive control to activate the building energy flexibility

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Background

- Energy flexibility of buildings is the ability to manage energy demand, storage and generation according to local climate conditions, user demands and grid requirements.
- There is growing demand for flexibility for different energy sectors in the grid due to the increasing penetration of the renewable energy.
- Model predictive control (MPC) is an effective technique to active the energy flexibility. It takes the system dynamics into account and implements the optimal control to minimize energy costs, provide grid services, or reduce the environmental impact of buildings during their operation.
- Meanwhile, the ongoing Smart Metering (AMS) plan in Norway will make it possible for buildings to implement MPC and provide flexibility to the grid on a large scale.



The ZEB Living Laboratory







- The response to a predesigned excitation signal will typically be used for identifying the model but usual operating conditions of the building will also be considered.
- grey-box modelling is the baseline approach but alternative models will be considered.



HVAC system



The modelling procedure will start from the heat dynamics of the building and come to coherently integrated system which includes HVAC system afterward.



General structure of the HVAC



The target for implementing MPC to HVAC system is to optimize the use schedule of the system based on the supporting information.

Information

supporting

the decision



Modelling the heat dynamics of the building

Heaters

•••





Current available data for modelling dynamics of the building





The objective is the loworder model for MPC





Main Model Structures (RC network)



First-order(Ti)



Second-order(TeTi)



Second-order(TeTia)



Third-order(TeTiTh)



Some results of the models (CTSM-R)





Residual analysis results of from the models (CTSM-R)



CTSM-R model TeTi

Matlab model TeTi



Best performance simulation results of the models (CTSM-R and Matlab)





3

Time [hour] (seconds)

5

 $\times 10^5$

model Ti

model TeTi



Simulation results from the model Ti and model TeTiTh









Questions?

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