Title

Master's thesis of

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I declare that I have developed and written the enclosed thesis completely by myself, and have not used sources or means without declaration in the text.

PLACE, DATE

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(Vivien Geenen)

Kurzfassung

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Hintergründe... Warum dieses Thema interessant ist

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Stukturierung meiner Thesis erläutern

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convection, conduction, solar irradiation

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Transmission to a electrical network RC-model

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empty

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"The idea of model predictive control [...] is [..] to utilize a model of the process in order to predict and optimize the future system behavior." Grüne and Pannek 2017 Applied to a thermal control of a building with the aim of grid- supporting, a model of the thermal behavior of the building is required to predict the reaction of the system behavior in the next N time steps, called the prediction horizon. Every time step k, the current state x_k, the output y_k and the future system behavior is obtained via measurements and computation. The computation of the future system behavior includes water forecast, occupant schedule and the optimization of the control signal u_k over the optimization horizon u_{k+N}. But, only the first calculated control signal is adopt as input for the plant. Then, the proceeding repeat every time step the calculations. Concluded, the MPC is "an iterative online optimization over the predictions" Grüne and Pannek 2017 compiled by the thermal model of the building. Mathematically explained, the optimizer needs to reduce the following equation according to Basil Kouvaritakis 2018 and Oldewurtel et al. 2012:

$$\text{Cost function} \qquad minimize \sum_{k=1}^{N-1} c_k(x_k, u_k, y_k) \tag{2.1}$$

subject to

$$\begin{aligned} \text{Current state} \quad x_0 &= x \\ \text{Dynamics} \quad x_{k+1} &= f(x_k, u_k, d_k) \qquad y_k = g(x_k, u_k, d_k) \\ \text{Constraints} \quad y_{min} &\leq y_k \leq y_{max} \\ u_{min} &\leq u_k \leq umax \end{aligned}$$

c_k represents the cost function, which is nearly explained in the next subsection 2.4.1 . In therms of building control, y is the internal temperature.

2.4.1. Cost function

The cost function c_k optimize the control signal u_k for the current state x_k, which is mathematically described in equation 2.1 , with:

$$c_k = (x_k^T Q x_k + u_k^T R u_k) \tag{2.2}$$

Here Q and R are matrices over which individual elements of the state vector or control signal vector can be weighted differently. **Kouvaritakis.2016** linear, quadratisch, gewichtet reduziert Zustand, stellsignal

2.4.2. Current state

The current state x_k is a vector of measured state variables of a building. Every prediction starts form this initial stateOldewurtel et al. 2012.

2.4.3. Dynamics

$$\dot{x} = Ax + B_1 u + B_2 d \tag{2.3}$$

$$y = Cx + D_1 u + D_2 d \tag{2.4}$$

2.4.4. Constraints

3. Modeling

3.1. The thermal model

internal mass, extern walls, considering/regarding as single zone building solar irradiation Hazyuk et al. 2012

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A. Appendix

A.1. First Section

Figure A.1. A figure

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