

Opponent's review of diploma thesis

Title: **Hierarchical Model Predictive Control for the Dynamical Power Split of a Fuel Cell Hybrid Vehicle**

Author: **Daniel Kloeser**

The presented diploma thesis is of very high quality, it is written very carefully and precisely and even though many parts were taken from other sources it required a huge effort and a lot of work. The author has shown a deep understanding of many different disciplines as physics, system modeling and control, mathematics or optimization methods. All the chapters and sections are written in details starting with the basics continuing to many details with a comprehensive survey and literature overview that is surely convenient for a reader but on the other hand it is sometimes difficult to distinguished what is the contribution of the author and what was adopted from the others which is very important for diploma thesis. For instance, what I appreciate is the idea of hierarchical structure of the control but this is probably not the original author's idea.

If I understand the thesis correctly the main contribution is that the author for the first time designs a control that comprises many different control tasks and requirements that was until now considered separately. This is surely very big achievement, on the other hand it requires to solve a complicated optimization problem that may be quite risky. Nonlinear MPC is an efficient tool but since almost nothing is guaranteed it requires a lot of testing, especially for parameter variations, failures or different regimes or external conditions. This is quite important and I miss deeper tests here but of course for a such complicated task one cannot do everything.

The presented diploma thesis is without any doubt a top class engineering and almost scientific work that I evaluate by the grade **“A – excellent”**.

Questions for defense:

1. You derive (or adopt) a very detailed model of all parts related to power supply and storage. Is the model somehow adapted with respect to MPC control (simplifications making the optimization problem easier)?
2. There are a lot of equations for each submodel but their basic properties are not clear, e.g. if it was possible to derive all the models in explicit form or what is the order of the models?

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doc. Ing. Petr Hušek, Ph.D. - opponent