HiWi/Master's Thesis

Implementation of Modern Control Theories on DC-DC Converters

DC-DC converters are meant to change on voltage/current level and supply power to a target system. Nowadays, DC-DC converters are widely used in all the electronic devices from personal computers to autonomous energy harvesting sensor nodes. One of the most important topics in design of DC-DC converters is the controller design, because it affects the performance of the converters, such as efficiency, dynamic behavior, error, output range etc.

The controllers which are used in DC-DC converters are often based on the classic control theory, such as PID, PI and lead controllers. These type of controllers are normally designed to stabilize Linear Time-Invariant (LTI) system and achieve required characteristics for a given system which is not the case in the power converters, where the system output and dynamics can change over time. In addition, due to non-linearity of the power converters, they are classified as Non-Linear Time-Variant systems in which classic controllers have quite limited performance. In the other hand, controllers based on modern control theory, such as LQR controller, and non-linear control theory, such as feedback linearization, can be designed for non-linear time-varying systems with better performance and higher degrees of freedom.

The aim of this work is to proof the concept of using the modern and non-linear control theory in DC-DC converters including theoretical analysis, design, simulation and comparison to the classic controllers.

Key aspects:
- Research into modern and non-linear control theorem and their implementations
- Linear and non-linear modeling of the DC-DC converters
- Design and simulation of the controller for a given DC-DC converter with variable load

We expect:

Eagerness to familiarize with the topic, interest and enthusiasm for linear algebra and control theory, plus a little bit of circuit analysis. Structured and well-documented working style.

We offer:

Intensive supervision of the thesis, a nice work environment, latest simulation and design tools, and room for creativity.

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