Master thesis:

"Real-Time Solution of Quadratically Constrained Quadratic Problems for Predictive Converter Control"

Model predictive control (MPC) of power converters has received much attention in both industry and the academic community in the last few years. Implementing MPC requires a (possibly non-convex) optimization problem to be solved in real time at very high sampling rates. Recent theoretical results have shown that for certain converter topologies, the non-convex MPC problem can be equivalently reformulated as a quadratically constrained quadratic problem (QCQP) with a certain structure. The master thesis will investigate the best way of solving these QCQPs at very high speeds.

Possible topics:

- Implement different optimization methods in Matlab or Python and compare the performance. In particular, compare;
  - interior point method
  - tailored gradient-projection method
  - SQP method
- Implement the preferred solver in simulation to evaluate the performance of the MPC.
- Implement the preferred solver on an embedded platform.
- FPGA implementation of a tailored solution algorithm developed in ABB.

Requirements:

- Basic knowledge of numerical optimization algorithms.
- Programming skills: C and/or C++, Matlab and/or Python

Supervision: The student will be in the ABB Corporate Research Center in Dättwil, Switzerland. Envisioned duration is 6 months. Supervision language is English. For students of engineering or mathematics from Freiburg, Prof. Moritz Diehl is available as academic supervisor.

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