Optimal Air Charge Control using MPC

Background

At Aurobay, we power the future with sustainable engines and hybrid solutions. To comply with fuel consumption and emissions regulation on an SI engine the air charge going into to the engine needs to be accurately controlled and estimated. When it comes to air charge control, several actuators come into play to achieve the target air flow: turbo-charger, throttle and the variable valve timing system (VVT). Conventionally, separate feed-forward and feedback-based controllers are used but since the actuators all effect the states on the intake and/or exhaust side in one way or another a more coordinated control method is desired. Model Predictive Control (MPC) is one method of interest to achieve this since it can control highly constrained multi-variable nonlinear systems.

This work aims at designing and implementing a MPC to control the turbo and intake VVT and compare its performance to the conventional control approach.

Activities and objectives

- Literature study on optimal control and MPC including previous master thesis work at Aurobay
- Develop simulation environment for engine plant model by combining turbo model and cylinder flow model
- Implementation and evaluation of MPC controller in simulation environment
- Implementation of MPC controller in the control unit of the engine (rapid prototyping or in ECU)
- Engine test in test cell to evaluate the controller performance and compare to simulation results as well as conventional control.

Student profile

- Strong skills in control system
- Proficient in MATLAB/Simulink
- Knowledge about internal combustion engine is a plus
- Suitable for two students

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