LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Master project, 2020-2021

— Design of electric motor for parallel hybrid vehicle by optimization on drive cycles —

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Context

The design of a traction motor cannot be based on a single operating point but must integrate all the operating modes characterizing the path of the vehicle it propels as well as the interactions with the other components of the traction chain. To simulate the vehicle operation, it is necessary to model each physics with precision and this for a set of standardized road cycles.

In the case of a parallel hybrid electric vehicle, the power required at the wheel for a road cycle can come from both the electric motor and the internal combustion engine, so a degree of freedom is added at each point in time.

It is then necessary to simultaneously optimize the energy management in the vehicle and the dimensions of the components to find the optimal powertrain without a priori on the control law. This is a difficult optimization problem due to the large number of variables and non-linear models. Solving it can be done according to several approaches that need to be investigated and compared.

Objective

This master project will study different approaches for the design by optimization of traction motor on drive cycles: nested, all-at-once, and iterative. For this purpose, a complete benchmark have to be built including vehicle dynamic modelling, drive cycle, models for powertrain's components, and sizing model for the electric motor.

Work steps

- Choose a test case: an engine, a drive train, and a road cycle
- Model the drive train over the road cycle and deduce its consumption
- Optimize energy management over the cycle to minimize consumption
- Build dimensioning models of the electric motor or other components
- Optimize the drive train and its control to minimize consumption over the cycle

Keywords

Drive cycle, design, optimization, energy management, parallel hybrid electric vehicle, electric motor