1 General Informations

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2 Thesis title and keywords

Contribution to the Optimization of Availability and Efficiency of Drivetrains of Electric Vehicles

Keywords: Energy recovery, Battery, Inn wheel Permanent Magnet Synchronous Motors (IWPMSM), DC/AC power converter, fault diagnosis, degraded modes management, adaptive control strategy, energy efficiency optimization.

3 Thesis subject

Many projections predict at horizons 2030 millions of Electrical Vehicles (EV) would be outstanding every day. The wide public using of these vehicles requires a maximum availability constraints (continuity of service) of theirs main functions including that of the drivetrain. The detection of defects that can cause failure of the vehicle (prediction of failures) is the first step in the strategy of the degraded modes management. Then, the driver must be able to have enough time to join a repair point through the triggering of a degraded mode of the drivetrain. The objective of this second step is to run the drivetrain in its best operating points (in terms of efficiency and dynamic performances) when it is in faulty regime. This will be done by adapting the controls laws and energy management system by acting on the parameters of regulators and developing fault-tolerant control laws.

The present thesis will exploit the background skills of the host laboratory in terms of fault prediction technics and fault tolerant control methods in order to improve the maturity and the reliability of the drivetrains of EVs. A focus will be made on the part consisting of the motors and their control device (battery - motors – DC/AC power converter). A particular intention will concern the faulty conditions during the power supplies but also during the recovery phases. These investigations will lead to propose a fault-tolerant architecture regarding to both hardware and software aspects. The theoretical approach of modeling and simulation will be validated with measurements from laboratory test benches.

4 Expected Collaborations

This work will continue the existing collaboration between UTBM (https://www.utbm.fr/) and Spacetrain (https://space-train) and it will create new collocations with new national and international partners with both academics and private institutions. One goal is to apply for French and European projects calls within the BPI, H2020 and FCH-JU programs.

5 Background

The proposed candidate will use using multi physical modeling process to build accurate model of powertrain's component including faults detections and degraded behavior during runtime. Moreover, the candidate will have to get strong skill in power electronics and drives in order to propose a fault tolerant architecture and to develop its control strategy for the drivetrain of EVs.

6 References

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