Optimization of scalaBle rEaltime modeLs and functIonal testing for e-drive ConceptS

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Publishable Executive Summary

One of the goals of OBELICS project is increasing the safety by factor x10. The purpose of WP 5 is to develop methods and tools for the proof of the safety and reliability improvement.
In order to achieve the quantitative estimation of increased safety and reliability the model of each power train component must be able to detect safety relevant properties.
A Method must also be developed to transform the data, simulated in models of WP2/3 to be used in quantitative analysis in the probabilistic FMEA (probFMEA), introduced in D5.1. Deliverable D5.2 analyses the connection between electric power train component modeling of WP2/3, and WP5.
The components in question are:

- Battery
- E-machine
- Inverter

Battery

The developed electro-chemical model features implementation of various degradation mechanisms with high fidelity and improved prediction capability. Some of the failure modes, described in probFMEA are modeled and their results can be extracted. The electrochemical model also offers an electric and thermal model of the battery package. The model is capable of placing a battery in a real environment; where the temperature behavior and state of charge can be evaluated. The results from the mentioned models carry a large potential for connection to probFMEA.

E-machine

The E-machine model currently produces results of some of the most important reliability and safety related failures of winding insulation ageing and PM demagnetization.
Different life factors can be detected at the end of the driving cycle, depending on which wire insulation is chosen for winding. In a real powertrain, a similar approach can be made by monitoring the winding temperature. Later, using the logged temperature data, the stator coil winding insulation lifetime can be predicted for a similar way of driving.
The PM demagnetization is affected by the temperature of the magnet and stator current. To prevent the magnet demagnetization, two mechanisms are proposed: cooling the magnet or reducing the stator current.

Inverter

The inverter model from VUB can simulate a closed loop control for an electric motor. The ambient temperature profile, mission profile and junction temperature from the model are very useful for forecasting analysis because they depend on reliability estimation, life consumption and prediction of failure mechanisms. The recorded data of actual mission profile and the ambient temperature will be required for this type of prediction and this logged data will be inserted into the simulation model to estimate the junction temperature. This approach makes it possible to investigate the reliability and life consumption estimation.

Further work on WP2, WP3 and WP5

Further work on WP5 for the battery, E-machine and inverter, regarding the topic presented in this deliverable, should involve more precisely determining the critical failures modes written in probFMEA. The critical failures should then be modeled in WP2 and 3 beside the existing models of failure modes from those work packages. Furthermore, the work with respect to these WPs should also focus on connecting and transforming results from the electric powertrain components to the probFMEA.

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Project partners:

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