ASTERICS

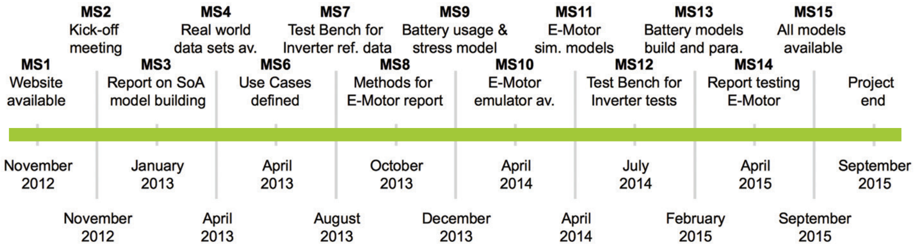
Ageing and efficiency Simulation & TEsting under Real world conditions for Innovative electric vehicle Components and Systems

MOTIVATION AND OBJECTIVES

The overall objectives of the ASTERICS project are:

- To develop a systematic and comprehensive approach for the design, development and testing phases of E-drivelines in Battery Electric Vehicles (BEVs).
- To reduce the overall development time and testing efforts for BEVs and BEV components by 50% compared to the current time and efforts.
- To enable improvement and optimisation of the overall efficiency and performance of electric vehicles by at least 20% compared to existing and known concepts.

PROJECT PLAN, MILESTONES AND DELIVERABLES



TECHNICAL APPROACH

The four building blocks, their features and the major innovations are:

- Real world environment and conditions based drive cycles.
- Advanced testing methodologies and models for E-driveline components.
- Descriptive/predictive models for battery subsystem, power electronics and electric motor.
- Total system (E-driveline and fully electric vehicle (FEV)).

ACHIEVEMENTS

Driving Cycle

An ASTERICS Driving Cycle (DC) was developed by performing three case studies with light and heavy vehicles. Additionally, an ASTERICS tool was developed, which allows simple DC data management. It can be used to build new DCs from raw data or to combine existing and newly generated cycles. Batch simulations using different DCs for each simulated event significantly reduces setup time.

Battery Parameters

Battery parameters with electrochemical impedance spectroscopy (EIS) at different states of battery ageing were identified and fitted an electric equivalent circuit (EEC) model to the measured impedance, which were then used to compare results of the lifecycle test.

Inverter Systems

Inverter arms models in Amesim and CRUISE were developed which include conduction and switching loss estimations based on semiconductor’s static characteristics at different assumption levels.

E-Motor

New Switched Reluctance Motor (SRM) and Permanent Magnet Synchronous Motor (PMSM) dynamic models based on the reluctant network approach as well as an improved methodology for integrating results from magneto-static and transient finite element analysis into system models for accurate loss calculation of SRM models were developed. The impact of different control strategies on losses and torque ripples has been studied.

Integration

A complete vehicle model for EV applications, including different models of the electric powertrain, such as battery, inverter and electric machine was created. For this different simulation tools such as AVL Cruise, LMS AMESIM, Per-FECTS, GSP were used in one environment to maximise the synergy with the other tools. The integration in a co-simulation environment through the Functional Mock-up Interface (FMI) or Mat-lab/Simulink allows to share libraries that are included in a common database between all partners.

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