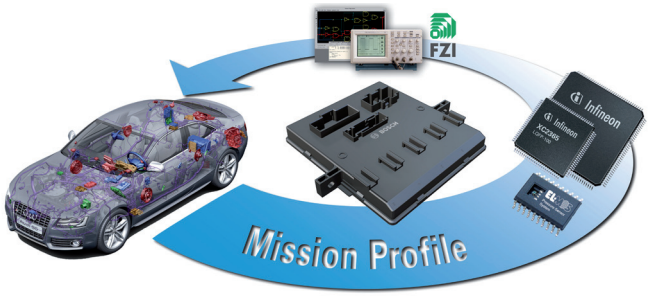
Objectives

Climate change has been recognized as a fundamental problem of mankind. Consequently, a key objective of climate policy is the limitation of global climate change to a deviation of 2° C in comparison to the beginning of the industrial era. One measure is the reduction of CO2 emissions in the transport sector of at least 20% until 2020.

Due to their tripled efficiency, electric cars are going to make a major contribution toward the accomplishment of this goal. Of course, there is a number of technical challenges to overcome, e.g. the required higher robustness of the electronic systems.

A very good example is battery management. It experiences its major strain during vehicle shutdown, during the charging process which can last from a few minutes to many hours. What used to be a rest period for electronics is now a time of additional, even maximum stress. In consequence, the requirement profile concerning operating life and robustness needs to be newly determined.

In RESCAR 2.0, robustness is precisely specified as a design command variable for the first time ever, it's taken into account during the whole development process from its beginning to verification. The complete value chain is being tied-in, from the car manufacturer (OEM) and the ECU producer (Tier 1) up to the semiconductor vendor (Tier 2). Among other things, battery management had been chosen as a model example and as demonstrator.



With this pioneering work, RESCAR 2.0 paves the way for the development of the especially high robustness requirements of the electronic systems of electric cars that are indistinguishable from conventional vehicles where comfort, safety and driving behaviour are concerned. This is a precondition for the wide acceptance required to reach the targets of climate policy.

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RES 2.0 CAR

Robustness in the Field of Electromobility

Robust Design of New Electronic Components for Electric Mobility Applications

A BMBF research project

Duration: February 2nd, 2011 till January 31st, 2014

Abstract

The objective of RESCAR 2.0 is the compilation of a common procedure which for the first time allows for conveniently taking into account the OEM's requirement profile concerning robustness already during ECU component design in a reliable and verifiable way. In order to account for the increasing sensibility of new technologies, three especially robustness-critical issues are being dealt with in depth: ageing effects influences of temperature and voltage fluctuations.

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WP1: Requirement profiles (Mission Profiles) and generic models for robust design

The basis for robust design is the knowledge of the components' field of application. Environmental influences and the respective particular boundary conditions (e.g. vehicle dynamics systems in an electric vehicle) need to be taken into account just like electric parameters, period of use and singular occasions. Those conditions can be summarized in so called Mission Profiles. However, compiling those is far from trivial. They need to represent reality sufficiently adequate and refer to relevant error mechanisms. At the same time they mustn't contain an uncontrollable amount of data since this would impede their efficient usage. Number and degree of detail of the measured parameters have to be as small as possible while still large enough. WP1 addresses the creation and the processing of the Mission Profiles. The objective is the creation of boundary conditions as well as the requirements for semiconductors for use in an electric vehicle that can be used during validation.

WP2: Designing reliability and robustness

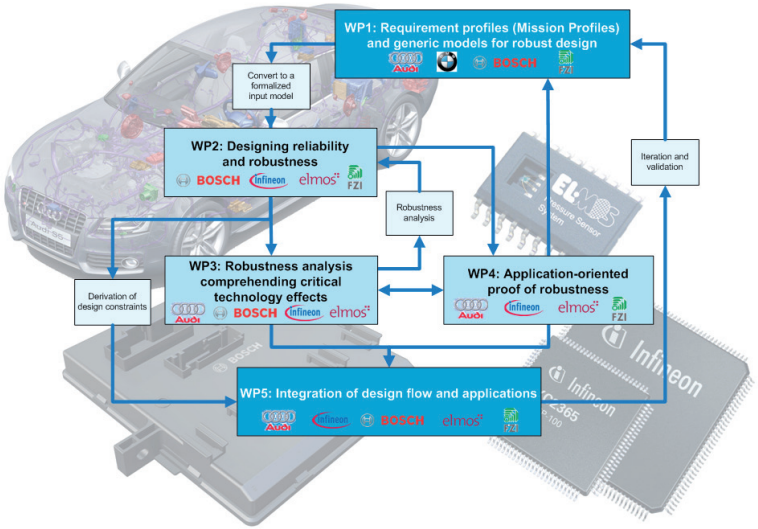
In AP1, a new classification is being developed in order to specify all relevant vehicle characteristics including special robustness requirements in a "Mission Profile". In order to take those requirements into account in the design flow, the objective of WP2 is the development of methods to transform those robustness demands into machine-processible constraints. These constraints are subsequently being used in the development of semiconductor components. In a prospective augmented design flow, the constraints not only need to be implemented but also strictly observed. Only those measures will allow for enhanced robustness.

WP3: Robustness analysis considering critical technology effects

The objective of WP3 is using robustness analyses for compliance of electronic components to higher robustness requirements in electric cars. These analyses are based on electro-mobility demonstrators defined in the project and take into account critical technology effects. In order to reach that objective, the two challenges of WP3 deal with researching and compiling different aspects of monitoring and analysing robustness.

WP4: Application-oriented proof of robustness

Higher robustness of an electronic automotive system means a smaller probability for areas in verification space that don't sufficiently comply with customer requirements. WP4 deals with predictive simulations and robustness verification by characterization, qualification and production tests with emphasis on applications aspects. In addition to the actual mixed-signal-ICs, the rapidly growing logic content needs to be taken into consideration, as well as the implemented safety functions, e.g. for the prevention of damage by overcharge or excessive temperature.



WP5: Integration of design flow and applications

The objective of WP5 is the proof of practicability of the procedures and methods developed in the previous WPs. Special emphasis is put on ensuring and proving sufficient integration and consistency of the design flow during specification, design and validation. The results of WP1 through WP4 have to be combined to a working design flow. The challenges of WP5 encompass integrating individual methods and components of the flow in order to establish a working design flow, proving that the methods and approaches are practicable, and verifying sufficient maturity and precision of the robustness models.

ICT - Germany's key technology on the way to the lead market for electric mobility

Electric mobility as a key technology plays an important role in the context of climate change and the finite nature of fossil resources: Increasing electrification of the power train as well as the exclusively electric drive offer an opportunity to strongly reduce CO2 emission and pollution, and decrease the dependency on imported fossil resources. Information and Communication Technologies (ICT) are crucial for many innovations in the automotive industry and have been essential for Germany's leading position in the world market. The federal government's goal is one million electric cars on Germany's roads in the year 2020. Germany will then become a lead market for electric mobility. A technological lead and guaranteed reliability of the electronic systems are key factors in order to reach that objective.

E-mobility: Complexity, reliability and robustness requirements

Electric vehicles will only be successfully established if usability, cruising range, safety and comfort are equal to today's cars with combustion engine. Robustness and reliability play a key role. They are becoming more important as high voltage power electronics for the motors are getting in direct contact with low voltage control logic, possibly resulting in various mutual interferences. The demand for higher performance in combination with the necessity of cost-effectiveness requires using state-of-the-art process technology in the electronic system design of electric cars in order to secure a competitive edge. Car manufacturers like AUDI depend on a timely supply of components that work reliably even at extreme temperatures, humidity and voltage fluctuations according to customer specifications. Convincing reliability is key for avoiding breakdowns and recalls of electric cars, and subsequently the wide acceptance necessary for a quick adoption of this new technology.

RESCAR 2.0: Robust design of new electronic components

The RESCAR 2.0 project partners develop methods and standards to predict and guarantee robustness and reliability of the complete system "electric car". RESCAR 2.0's spadework makes it possible to endow electric cars of the future with the enhanced safety, reliability and comfort that distinguishes German car manufacturers from their competition today. This secures Germany's role as a precursor of climate-conscious politics, as home of technologically leading companies and, above all, as Europe's most important location of the automotive industry..