

# Current Trends in the Design of Automotive Electronic Systems

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## Abstract

Future developments in the automotive industry will be governed by a variety of different requirements. Our vision of a modern vehicle includes comprehensive safety, a high degree of comfort, low energy consumption, and minimal pollutant emission. These demands can only be accomplished by employing interconnected intelligent electronic devices, capable of processing and sharing information about the car, the driver, the environment, and others sources of data. The implementation of such features will be critical for the manufacturer's success and puts a high pressure on the development process itself and the hardware- and software-tools used for every step in this process.

Today's situation in this field is characterized by three distinct development phases: First, the analysis and design of functionality. This type of work is typically performed in the laboratory, i.e. on the desk. Second, the implementation of a prototype system, realized by (semi)-automatic code generation and followed by a test with a "Lab-car" or in a real vehicle. The third and final step comprises the calibration and fine-tuning of algorithms and their parameters, commonly done in a real car. However, there are some flaws associated with this approach. There is no support for multiple interconnected electronic control units. Automatic generation of code of production quality is still a challenging task. And there is a large gap between the properties of a virtual car and the behavior of the real vehicle. The latter is one reason why nowadays the adjustment of calibration parameters still needs to be done manually.

In the future, the picture outlined above will change remarkably. Function development tools will be able to generate efficient and reliable software code automatically. Vehicle models will mimic the characteristics of the real object to an extent we cannot imagine today. And automated test and calibration without manual interference will allow for an unprecedented degree of optimization and quality throughout a complex network of electronic control units. Almost the entire development process will be shifted to the desk with no need for costly, risky, and error-prone experiments with prototype engines or vehicles.

To achieve such a technologically sophisticated level, an extended concept of engineering tools is needed. As the majority of work within the development cycle will be performed in "virtual reality", the borderlines between the different development phases gradually disappear. Then, even at a very late stage, it would be possible to change the principal software design without having to start from scratch again. In other words, the well-known "V-cycle" turns into a continuous process with no barriers between the different areas. In such a scenario, it is essential that every tool works smoothly together with any other tool of the development suite. Hence, well-defined and open interfaces as well as concurrent support for automation are key elements for future success. As to the final implementation, wireless communication via radio transmission corporate networks will facilitate data transfer and adjustment significantly, thus enabling engineers to pursue test and calibration tasks much more comfortable, even from remote locations.