Research Project E-Performance - In-Car-Network Optimization for Electric Vehicles

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Abstract

In the automotive domain the permanent increase in functionality led to a vast number of electronic control units (ECUs) in today’s cars, but packaging and network bandwidth demands became problematic in the last years. Thus it is vital to integrate more functions per ECU and shift in-car-networking complexity into software. To master this challenge, it is essential to find local and global optimization possibilities, which includes practical software component partitioning strategies while not overlooking the multiplicity of influence factors as well as smart software modules that help to reduce the energy demand wherever possible.

1 Introduction

The development of Electric Vehicles, in some facts, is a contradictory challenge that ought to combine customer expectations, quality and price. Knowing that the prospects on the cruising range of comparable combustion-engine vehicles cannot be realized contemporarily on battery-electric vehicles, a large variety of other automotive characteristics must be redefined. The redesign of these characteristics, going along with totally new approaches in vehicle characteristics, is indispensible for increasing the customer’s benefit. The resulting layout criteria are not yet sustainably verified because of their mostly unknown, multi-variant interaction.

Therefore, the joint research project „e performance“ is meant to demonstrate technical and economical feasibility on the basis of a re-usable module kit (see Fig. 1). This publicized, integrated development approach on the basis of „E-Modules“ will be exemplarily demonstrated and evaluated using a collaborative vehicle concept called „e-tron research car 2012“ [1,2,3].
One of the mentioned “E-Modules” on the car is the network architecture including the software components. Nowadays modern vehicles with combustion engines comprise 80 electronic control units (ECUs) or more. This comes as a result of the rapidly increasing number of vehicle functions and thus in-car communication demand.

The continuous increment of driver assistance functions in the last years is likely to be the main contributor to the rising demand in network bandwidth. This includes adaptive cruise-control (ACC), traffic sign recognition, night vision, automatic parking and many more. What all these functions have in common is their background in image processing. As current network architecture layouts can be seen as a distributed system in this area this leads to massive communication of image data between sensors and control units. A second contributor is the infotainment system, where in the latest generation of premium cars, it is even possible to stream music and movies from the central system in the dashboard to the rear seats. Also in the last years, vehicle dynamics functions have consequently grown and need high speed real-time communication between the components. Torque vectoring can be seen as an example here.

To handle all these and also future functions, and at the same time avoid a further increase of the number of ECUs and bandwidth demand, new concepts have to be developed and prototypical tested.