EE-VERT
Energy Efficient Vehicles for Road Transport

Executive Summary

Road transport is the second largest producer of greenhouse gases within the European Union. EE-VERT targets a 10-12% reduction in fuel consumption and CO_2 generation for conventional vehicles at an attractive cost-benefit ratio. The central EE-VERT concept is the electrification of auxiliary systems, operating them demand oriented and supplying their energy by CO_2-neutral energy from energy sources such as extended recuperation of braking energy, waste heat recovery or solar cells, using an overall energy management strategy. To achieve improved efficiency and power the generator operates at 40V and to connect the elements to the standard electrical system a new architecture has been devised that works with 40V and 14V levels.

The main components of the 40V network are a new generator based on the claw pole technology with integrated permanent magnets, a Li-Ion battery system and a DC/DC converter with multiple inputs (MIPEC) for interfacing between the two voltage levels. The available generator power during recuperation is up to 11kW. The efficiency of the new generator is above 80% in the low range of speed while in the high range of speed the efficiency is still above 70%. The MIPEC efficiency is around 94%.

The generator, Li-ion battery and MIPEC were integrated into the high voltage network, firstly on a test bench and later in the demonstrator vehicle. Optimised and electrified actuators including a fuel pump and a vacuum pump together with a commercial electrical AC compressor and a solar panel were also fitted to the demonstrator vehicle. In addition an electric actuator for the VTG turbocharger was developed and successfully tested on an engine and new electric actuator designs suitable for .an AC compressor were evaluated on the test bench. The safety implications of introducing a dual-voltage architecture were also investigated.

A simulation software "platform" was developed, using Matlab/Simulink, which models the project reference car, an Alfa Romeo 159. This simulation model is based on specifically developed models for each of the new components mentioned and realistic models for the other elements in the vehicle.

Results

The simulation work indicates that average fuel savings of 10% for real life driving cycles and up to 20% when the start and stop functionality is applied to real life urban cycles are possible and that real life urban driving cycles benefit the most from the EE-VERT concept. Fuel consumption results for the demonstrator car validated the simulation work, confirming that the EE-VERT concept can lead to fuel savings of 10-20% depending on the mission cycle for a modest increase in costs.

Partners: MIRA Ltd, Volvo Technology Corporation, Centro Richerche Fiat, Robert Bosch GmbH, Lear Corporation, Engineering Center Steyr, FH Joanneum, Universitatea Politehnica din Timisoara, Beespeed Automatizari

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