Study of flame propagation and knock in a turbocharged compressed natural gas engine

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Abstract

During the CEV (Clean Engine vehicle)-project modifications on a gasoline fuelled engine were carried out in order to reduce CO_2-emissions about 30% in monovalent CNG operation compared to a gasoline production car with equivalent performance and to fulfil EURO 4 emission standards. Furthermore, the CEV have to meet the Californian Super-Ultra-Low-Emission-Vehicles (SULEV) emission standards.

Simulation tools have been utilised successfully in the CEV-project. Detailed simulations aim at reducing experimental investigations on the engine and roller test bench. The newly developed combustion model was used to predict the fuel consumption and has been validated on the engine test bench. The CEV-strategy focuses on increasing the part load efficiency. Several investigations were made to find the optimal strategy through simulations. The influence of a higher compression ratio was calculated in the engine map, whereon the pistons of the engine were replaced. The predicted results were in good agreement with experimental data. The waste-gate-strategy was adjusted for the turbocharged CEV-engine using simulation tools. This steady-state calculations could be extrapolated to transient operating conditions to examine several transmissions and to predict the fuel consumption in the NEDC (New European Drivng Cycle). While EGR (Exhaust Gas Recirculation) influences the burn rate, the distribution and mixing of EGR with air in the intake manifold was investigated. Modifications on the throttle were carried out in order to achieve a homogenous EGR-air-mixture.

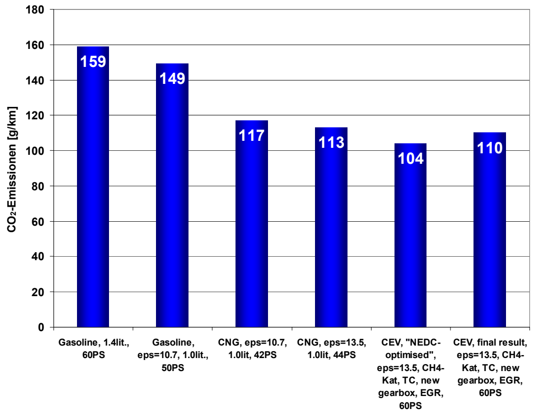
1 Topic of thesis

The combustion and the knock behaviour will be described by combining theoretical models with experimental data.

2 Projected solution

The models will be implemented into a commercial software (GT-Power) to be able to use them for succeeding projects. A wide range of operating points will be used to validate the model.

3 Results



The ambitious goals in the CEV-Project could be achieved. The optimised CEV was tested on a roller test, whereby the CO2-emissions could be reduce by more than 30% and the emission standards were fulfilled.

Due to the use of simulation tools, experimental investigations were reduced and the complex interactions of different engine components could be tested. The influence of the combustion chamber design was described when the compression ratio was increased. This was useful for a better understanding of the experimental results.

Fig 1 CO_2-Emissions in the CEV-Project

4 References

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