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Virtual Air Path Calibration of a Multi Cylinder High Performance GDI Engine Using 1D Cycle Simulation

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ABSTRACT

The increasing complexity of engines and engine management systems greatly increases the effort required for their calibration. This conflicts with the need to reduce development time, due to shortening development cycles and increasing cost pressures. The time spent on the development process can be reduced by calibrating the engine in a “virtual environment” using simulation.

This work is concerned with the virtual air path calibration of a multi-cylinder high performance Gasoline Direct Injection engine using a one-dimensional gas dynamic code. The model had been previously constructed and used to optimise the manifold geometry to meet the full load performance targets.

This paper describes how the simulation was modified to cover the full range of engine operation and its results used to create the “first-cut” of the Air Path Model, a vital component in the engine management system.

The virtual Air Path Model constructed using 1D simulation has been assessed against an Air Path Model constructed from measured data taken during engine testing in a later stage of the project. A detailed comparison of the results is shown in this paper and the accuracy of the predictions discussed.

From this comparison, it can be seen that the 1D code is capable of generating a virtual air path calibration that meets the standards required for a concept level calibration, suitable for a demonstrator vehicle, saving a significant amount of test time during the calibration process.