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Integrated Simulation, Analysis and Testing of a Variable Valve Train for Passenger Car Diesel Engines

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ABSTRACT
The need to meet ever more stringent emission legislations over the last decade has led to a significant increase in diesel engine complexity. A typical modern passenger car diesel engine now features variable geometry exhaust gas turbocharging and variable charge motion in combination with exhaust gas recirculation.

Further improvements are still required and one technology that has the potential to improve fuel economy and reduce emissions is variable valve timing. This gives the ability to alter in-cylinder charge motion and effective compression ratio. In doing so, it not only alters in-cylinder pressures and temperatures, but also the operating point of the turbocharger and EGR system.

This paper demonstrates how both 1-D and 3-D numerical simulation have been used in conjunction with engine testing to analyse the fundamental effects and separate the interactions. Using an asymmetric valve timing technology to enable both early and late intake valve closing, the effects and benefits of various operating strategies are discussed. The numerical simulations provide a fundamental insight in the governing behaviour of the engine and allow the initial design to be optimised. Engine testing and combustion analysis are used to demonstrate the effects of variable valve timing on the engine and explain how improvements in emissions and fuel economy can be achieved.