Flexible ECU Function Development Calibration and Engine Performance Assessment Based on Co-Simulation

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ABSTRACT

The open MAHLE Flexible ECU (MFE) was developed and successfully implemented for controlling gasoline, diesel and hybrid engines. The increased demand of new functions development to address future powertrain challenges, such as lower fuel consumption, ever more stringent emissions legislative targets as well as the need to reduce development time and cost at the same time, led to the incorporation of the MFE functions in a co-simulation environment.

The co-simulation environment consists of using the virtual engine developed with 1D or 3D numerical simulation tools and the functions of MFE developed with Simulink-Targetlink. This co-simulation approach allows modifying either the engine control or the engine itself. Regarding the engine control and its development, the existing and new functions were tested for the performance, emissions and behaviour changes on several production and prototype engines. The MFE has capability to generate the first calibration prior to experimental validation work. The use of a real validated engine control structure enables further integration and testing of new engine components and systems, such as pressure charging, EGR, exhaust after treatment and also concept tests.

This paper shows the benefits of the co-simulation using a full structured engine control with a 1D engine model. The development of a combined boost and EGR controller for a 2 stage turbo charged diesel engine is presented.