Increase Efficiency of DeNOx Aftertreatment System Integration Process using AVL's Modeling Know-how.

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October, 2009

It is becoming increasingly obvious the future US and European emission legislation targets will be only achieved by development of cleaner combustion processes and more efficient aftertreatment systems. Although these technical challenges have been addressed individually by engineering communities in the past years, a cost efficient design and system integration process seems to remain an ongoing challenge for on/off road truck manufacturers and their suppliers. In the past twenty five years, AVL had integrated its over six decade powertrain design experiences in a series of CAE tools which address cost effective aftertreatment system integration processes. This contribution describes AVL's workflow to lay out and integrate DeNOx aftertreatment systems in various design stages by utilizing AVL CFD code, FIRE®.

The simulation approach is performed in two steps. First, the accuracy of the models describing the behavior of DOC, DPF, SCR, urea dosing unit and pipes is refined in an automatic calibration process using experimental data. In a second step, these well defined virtual components are used within an entire system simulation process to compare the DeNOx-performance of different system configurations during drive cycles.
Special focus is put on urea injection where a 3D model is applied to describe the transport of urea-water droplets, evaporation of water, thermolysis of urea, droplet wall interaction, build-up of wall-films and the influence of mixing devices. The thermal behavior of segmented DPF is investigated in 3D capturing the impact of segmentation walls on pressure drop and temperature distribution during forced regeneration events. An outlook is given on how to integrate 1D exhaust system models in the framework of Software-in-the-Loop (SiL) applications. Due to the combined and systematic application of 1D and 3D simulation models the overall exhaust system performance is captured by a solid simulation tool chain with sufficient physical details and an appropriate computational effort.

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