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[Home](#) > Approaches for Acoustics Simulation for Automotive Air Induction & Exhaust Systems

Approaches for Acoustics Simulation for Automotive Air Induction & Exhaust Systems



Acoustic design of automotive air induction and exhaust systems is commonly based on empirical methods, linear acoustics (transfer matrix methods) and one-dimensional, non-linear CFD simulation. In addition hardware testing is adopted for the calibration of components like mufflers and resonators. Finally with the intake or exhaust system mounted to the engine, bench testing is used to verify targets for noise regulation and to confirm brand sound characteristics.

Today 3D CFD simulation is still rarely used for acoustics analysis of intake and exhaust systems, mainly due to the required compute power. Depending on the frequencies to be resolved a transient analysis with high resolution in space and time can easily take a high-performance computing cluster to its limits.

For mid-size compute clusters InDesA has developed acoustic applications with STAR-CCM+ for the prediction of acoustic transmission loss or transfer functions for air induction systems, resonators and exhaust mufflers. Results can be either used for design optimization, design verification or for the calibration of 1D simulation models speeding up the developing process significantly.

Finally, a coupled 1D/3D CFD method will be presented to capture tail pipe noise of exhaust systems to assess different tail pipe designs.

Author Company:

InDesA GmbH

Author Name:

Fabiano Bet, Gerald Seider, Simon Bless

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