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Aeroacoustics of HVAC Systems: Simulation and Experiment

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The sound field in the passenger cabin is dominated by its air conditioning system (HVAC) by a driving velocity in a range below 100 km/h. Their emission is characterized mainly in a broad band spectra distribution. The presentation is focused in two parts. First the sound perceptions of vehicle occupants are analysed. Besides psychoacoustic parameters like loudness and sharpness also a stochastic change in in the broadband sound spectra pattern is important. Additional the sound is strong influenced from in inclined angle of the windshield window, the size of the cabin and the interior impedance condition. In respect to this parameter a simplified car model was designed and constructed to get a better physical understanding of the HVAC system acoustic.

The second part deals with the different HVAC components. Using hybrid method different formulations of the acoustic source terms were applied and compared with experimental results. It was done for different components of the HVAC system like outlet, condenser unit and blower. A big challenge was the sound prediction of the rotating blower unit. To predict the flow field with a high spatial and temporal resolution mainly high performance computer systems (HPC) were used. Finally the results show a good agreement with the experiments and confirm that computational aeroacoustic (CAA) can be a useful tool in a complementary approach to analyse then sound field of a HVAC system.