Numerical predictions of the vibro-acoustic transmission through the side window subjected to aerodynamic loads

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Abstract:

The acoustic comfort level in modern car design mainly depends on the aerodynamic noise generated at high speed. This noise is characterized by a mid- and high- frequency spectrum and mainly radiates inside the passenger cabin through the different car glass surfaces. Predicting such noise can be done by coupling a Computational Fluid Dynamics (CFD) code solving the compressible turbulent flow with a vibro-acoustic simulation software. The simulation of the flow around the vehicle gives access to the wall pressure applied on the car glass surfaces, while the vibro-acoustic model takes this aerodynamic loading as excitation to predict the internal noise.
In this paper, the vibro-acoustic frequency response of an existing Finite Element (FE) model is extended using a Statistical Energy Analysis (SEA) approach called Virtual SEA. In this approach, that simulates an experimental SEA process, the necessary information required to build the SEA matrix are extracted from the FE models. The evaluation of the injected power corresponding to the wall pressure field, which excites the Virtual SEA model, relies on the decomposition of the glass surfaces wall pressure into a turbulent and an acoustic contribution.

Finally, the efficiency of the proposed methodology is demonstrated on an industrial car model, where numerical acoustic responses predicted by the Actran software are compared to experimental data measured in wind tunnel over a large frequency range.

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