

POWERFLOW FOR UNDERBODY WIND NOISE

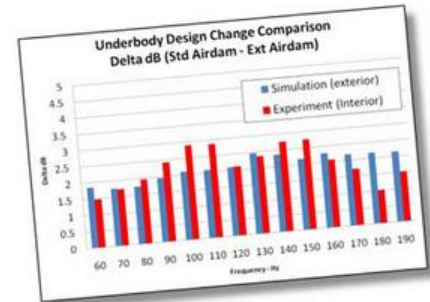


3DEXPERIENCE®

Keep Underbody Wind Noise Under Control

Great strides have been made in reducing powertrain and road/tire noise, such that wind noise has become the dominant noise source during highway driving, directly impacting consumer brand loyalty and sales.

Paying attention to underbody wind noise has become important because it can be a significant contributor to interior noise quality in the low-frequency range (< 500 Hz). OEMs seek to improve fuel economy and reduce CO2 using spoilers and underbody panels, but these components contribute to underbody wind noise and should be factored into design decisions. Because the underbody of a vehicle has a complex shape and many components, it can be difficult to assess the cause of underbody noise experimentally, and is typically not done until late in the process when physical prototypes are available. However, at this stage, designs are extremely difficult and expensive to change. Therefore, a digital capability to predict and reduce underbody wind noise early in the vehicle development process is highly desirable.



Technical Challenges

Underbody wind noise sources are complex flow structures involving separation, vortex convection, and reattachment; with strong dependence on the detailed underbody geometry. Typically, the largest underbody noise sources originate from flow separations at the wheels, wheelhouse, engine/exhaust system, suspension, and structural cross-members. The resulting pressure fluctuations excite the underbody floor-pan structure and radiate into the vehicle interior as low-frequency noise. Accurate simulation of these noise sources requires solution of the time-varying flow structures and resulting wall pressure fluctuations (WPF) on the underbody surfaces. In addition, the ability to accurately capture energy-containing anisotropic structures and convection of cascaded turbulent structures over a wide range of length scales is necessary. Visualization of the flow structures that result in high WPF on underbody panels is useful to provide insight into geometry features that are good candidates for design improvement. This kind of noise source identification is extremely difficult to achieve experimentally, and is often not possible until far too late in the design process.

SIMULIA Solution

PowerFLOW, coupled with PowerACOUSTICS, offers a complete solution for simulating all important wind noise sources, and predicting their contribution to the full-vehicle interior noise. This digital approach enables you to evaluate the wind noise performance of aerodynamic design changes to the underbody region early in the development process. PowerFLOW's unique technology, an inherently transient solution, provides accurate prediction of complex flow structures and corresponding noise sources in the underbody region. The noise transmission module in PowerACOUSTICS uses the transient loads on the underbody panels to predict the

underbody contribution to the total interior noise. Detailed flow analysis can be done with PowerACOUSTICS in both time and spectral space to obtain insight into the transient nature of the flow field in the underbody region, enabling you to identify design modifications to reduce the flow excitation loads on the underbody panels that contribute to the interior noise. Complex geometries are handled easily and rapid turnaround time provides valuable feedback to address aerodynamic efficiency and wind noise simultaneously. PowerFLOW enables you to understand the underbody noise characteristics of vehicle designs very early in the development process — before costly physical models or prototypes are built.