

POWERFLOW FOR GREENHOUSE WIND NOISE



3DEXPERIENCE®

1. Get the Inside Story on Wind Noise

Reducing vehicle interior noise levels for driver and passenger comfort is a key concern for acoustic engineers, directly impacting consumer sales and brand loyalty. Because powertrain and road/tire noise have been greatly reduced, wind noise is now the dominant noise source during highway driving. Therefore, a significant amount of engineering time and product cost is being invested to achieve interior noise targets and remain competitive in quality. Typically, OEMs cannot assess wind-related interior noise until late in the development process, when high-quality verification prototypes are built. At this point, it could be too late to efficiently resolve noise problems, thereby requiring design rework, an additional sound package, or acoustic glass attenuation—all expensive and time-consuming solutions. To reduce the associated costs as well as development times, there is a strong need for a reliable numerical prediction capability for use early in the development process and throughout the program life cycle.

Technical Challenges

For a vehicle traveling at highway speeds, turbulent flow produces a distributed force excitation on the greenhouse panels (for example, side windows and windshield), generating an acoustic field that acts on these panels. The greenhouse noise sources are complex transient-flow structures produced by flow separations and vortices resulting from various exterior geometry features such as the cowl, A-pillar, and mirror assembly. Accurate prediction of greenhouse noise sources requires predicting the time-varying flow structures and resulting wall pressure fluctuations on the greenhouse panels, including effects of small geometric details. The turbulent excitation, panel vibration, and acoustics are of widely varying length scales (the wavenumber spectrum), providing a significant technical challenge for accurate prediction over the important frequency range. Sound transmission of the exterior acoustic field to the interior is particularly important near the acoustic/structure coincidence frequency, and appears to be significant even though the turbulent wall pressure amplitudes far exceed those of the acoustic pressures.

SIMULIA Solutions

PowerFLOW, coupled with PowerACOUSTICS, offers a complete solution for simulating all important wind noise sources and predicting their contributions to the full vehicle interior noise. PowerFLOW predicts transient flow around the vehicle, including highly accurate prediction of key noise-producing flow structures (such as the A-pillar vortex and mirror/pedestal/sail wake, which directly impact the front side glass). PowerACOUSTICS converts the resulting time-domain pressure signals everywhere on the panels into structural power inputs, used as input to a fast-running Statistical Energy Analysis (SEA) model that predicts the noise inside the cabin. This approach quantifies the wind noise contribution coming from different panels at driver/passenger head space locations inside the vehicle. The predicted spectra can be converted to audio files for comparative listening to the effects of various design options. The PowerFLOW suite's complete solution goes beyond what is practical in physical test by enabling you to gain insight into the behavior of key turbulent flow structures and corresponding greenhouse noise sources for targeted shape-design improvement. This industry-first capability

enables you to analyze potential noise reduction solutions (including exterior shape changes, glass properties, and interior acoustic package modifications) early in the vehicle development process, before costly physical models or prototypes are built.