

POWERFLOW FOR COMMUNITY OR PASS-BY NOISE



3DEXPERIENCE®

Please Keep it Down Out There

Noise pollution from vehicles, airplanes, trains, and heavy machinery is steadily increasing — with proven adverse health effects for people in nearby communities. Therefore, government regulations for community noise are getting more stringent in most countries. This creates significant challenges for vehicle and aircraft manufacturers forced to meet these ever increasing regulatory requirements.

Noise control engineers must be able to identify the main sources of noise generated by turbulent flow or mechanical vibrations — before designs are finalized. Assessing compliance with community noise regulations too late in the design process often leads to costly design changes, expensive repeat testing, and could jeopardize product certification.

Although a great deal of progress has been made in understanding sound generation and propagation mechanisms, the use of this knowledge to improve acoustic technology and meet community noise targets remains a major challenge for the transportation and heavy equipment industries.

Technical Challenges

A major challenge in meeting noise targets is assessing and reducing noise sources while dealing with several other design constraints. The time and cost of developing and testing physical prototypes are often prohibitive. Experimental testing challenges also include wind tunnel space limitations for extending measurements to the far field, and relating stationary-source wind tunnel measurements to the real-life, moving-source scenario. Therefore, a computational solution is highly desirable.

A key challenge for Computational Aero-Acoustic (CAA) methods is that sound propagated to the far field consists of pressure perturbations that are very small relative to the turbulent pressure fluctuations in the near-field source region. Therefore, highly accurate prediction of the transient flow behavior with sufficiently low dissipation and dispersion is required to resolve small amplitude fluctuations over the frequency range of interest. Moreover, in typical applications such as aircraft or train certification, the far-field noise target involves large distances, making it impractical to extend the computational domain to include both the source region and the receiver.

SIMULIA Solution

PowerFLOW, combined with the PowerACOUSTICS far-field noise module, provides accurate numerical prediction of flow-induced far-field noise, enabling you to simulate community noise problems for aircraft, rail transport, and rotating machinery applications.

The SIMULIA integrated far-field noise solution provides:

- Accurate transient flow fluctuation prediction: Leverages PowerFLOW's proven accuracy for the prediction of aerodynamically induced noise: time-unsteady and able to handle complex detailed geometry.
- Fully coupled far-field noise solver: The fully integrated Fowcs Williams and Hawkins (FW-H)-based solver predicts time signals at receiver/microphone locations. The solver supports options for fly-over/pass-by versus wind tunnel scenarios, and solid versus permeable configurations.
- Ability to predict fan and rotating machinery noise: PowerFLOW's ability to simulate true rotating geometry to predict pressure fluctuations generated by rotating components, coupled with the far-field noise module, provides an accurate solution for rotating machinery noise applications.
- Noise metrics and digital certification: The far-field noise module outputs time-domain pressure signals, to which any user-specific post processing can be applied.
- Insight on noise source locations: The far-field noise module provides a contribution analysis of the noise sources, highlighting the near wall regions contributing the most to the far field. You can use the output far-field signals as input to inverse methods such as beam forming or acoustic holography, which provides spatial noise source localizations.

The complete SIMULIA far-field noise solution provides early noise assessment and optimization, before a final prototype is built. Complex geometry handling and efficient post-processing allow rapid turnaround time for noise assessment during the early design phase, giving confidence that noise targets will be achieved.