PowerACOUSTICS

SEEKING QUIET

Assessing wind and industrial noise pollution levels is becoming increasingly important to transportation manufacturers. Consumers demand quieter vehicles while government regulations demand reduced community noise.

J. D. Power and Associates' initial quality surveys indicate that wind noise is consistently the number one consumer complaint, directly impacting consumer brand loyalty and vehicle sales. Reducing interior noise levels to achieve occupant comfort is therefore at the forefront of acoustic engineers' concerns.

Additionally, with increasing air, rail and highway traffic, the amount of noise propagated into the community neighborhoods also has escalated. In order to remain customer competitive and compliant with government regulations, today's manufacturers need to be able to assess their designs' acoustic impact early in the development process.

SEEING & HEARING NOISE *BEFORE* IT HAPPENS: A CHALLENGE

Interior and far-field noise levels are typically not assessed until late in the development process when prototypes are built. This is often too late to make significant changes to the product design—requiring late stage design re-work or sound package upgrades such as thicker and/or laminated glass, adding significant cost and weight.

Acoustics engineers face numerous challenges: acoustic wind tunnel tests are expensive, flow visualization and noise source identification are difficult, and testing is not possible until physical prototypes are available. A numerical simulation approach is highly desirable for early design assessment. However, most available numerical solvers do not provide accurate   prediction of complex transient turbulent flow, required for effective acoustic simulation. PowerFLOW's unique transient and compressible flow solver technology allows engineers to simulate and visualize the flow-induced sources of noise and resulting transient pressure loading on the external surfaces.

PowerACOUSTICS is Exa's flagship aeroacoustics product, providing leading edge aeroacoustic analysis for flow-induced noise. PowerACOUSTICS, paired with PowerFLOW, enables accurate pressure fluctuation prediction, noise source identification, wind noise transmission to interior, propagation to the far-field, and sound package parameter study capabilities.

PowerACOUSTICS provides a complete, extensively validated, digital solution, enabling aeroacoustics and noise control engineers to efficiently collaborate to optimize the exterior shape and sound package design to meet noise targets.
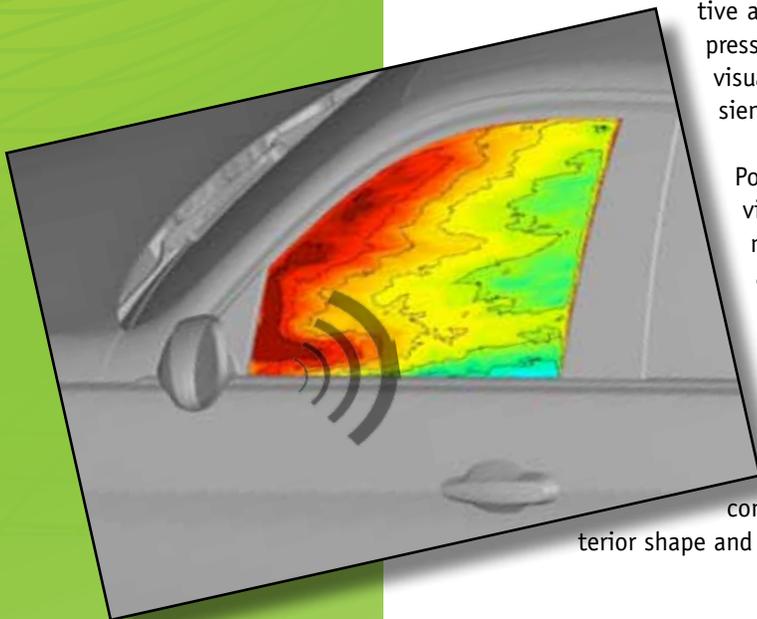
PowerACOUSTICS enables interior wind noise analysis of exterior shape changes, glass properties and interior acoustic package modifications to minimize sound at an occupant's ear.

Exa

PRODUCT BENEFITS

ASSESS WIND NOISE PERFORMANCE THROUGHOUT DEVELOPMENT LIFECYCLE

Exterior wind-generated pressure load data from PowerFLOW is seamlessly combined with PowerACOUSTICS' structural-acoustics and far-field propagation solvers to provide the wind noise contribution to the sound at the occupant's or receiver's location. The ability to simulate noise early in the product development workflow enables acoustic engineers to analyze and address wind noise issues throughout the development process.

REDUCE DEPENDENCE ON PROTOTYPE WIND TUNNEL TESTING

PowerFLOW coupled with PowerACOUSTICS provides a digital aeroacoustic facility which is extremely cost effective relative to physical test and provides enhanced capability through detailed visual insight into how design features and changes impact the noise sources.

RELIABLE, VALIDATED SOLUTION

Exa's well-recognized aeroacoustics technology team has extensively validated PowerACOUSTICS predictions against experimental data, and has developed best practices embedded in application templates for ease-of-use.

LISTEN TO YOUR SIMULATIONS

Compare design alternatives using PowerACOUSTICS' audio signal synthesis. Easily convert your SPL files from your simulation into .wav files. Isolate and evaluate data by listening to each sample and comparing sound clips.

EXPLORE POTENTIAL SOUND PACKAGE COST & WEIGHT SAVINGS

Rapidly evaluate the impact on interior noise of various sound package configuration options to help meet wind noise targets—at minimized cost and weight.

PROVIDES CONFIDENCE THAT PRODUCTS WILL PASS REGULATORY TESTS

Assess noise performance against regulatory requirements to improve ability to design products that pass physical tests the first time.

PowerACOUSTICS®

Interior Noise Transmission Module

Far–Field Noise Module

Signal Processing (Base) Module

Signal Processing (Base) Module

CALCULATE STATISTICS AND SPECTRA
Easily calculate single-point or two-point statistics and spectra: auto-correlation and auto-spectrum, cross-correlation and cross-spectrum, coherence functions and more

FAST FOURIER TRANSFORMS
Selectable frequency resolution and time window functions

PERFORM BAND–LIMITED FILTERING
Highlight sources of problematic frequencies

COMMUNICATE YOUR RESULTS
Quickly and easily generate many types of technical graphs and/or choose to output to Exa PowerVIZ® for 3D visualizations

CREATE SOUND FILES
With audio signal synthesis and SPL graphing, it is easy to generate sound files, convert spectra between different bandwidths and to calculate A-weighting or loudness in sones

LEVERAGE YOUR HARDWARE
Parallel computation for high performance
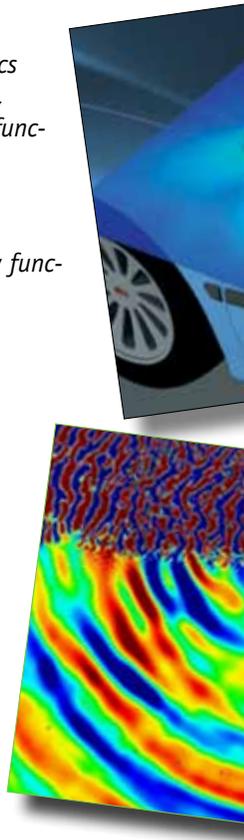
EASILY INTEGRATE AEROACOUSTICS SIMULATION INTO YOUR PRODUCT DEVELOPMENT PROCESS

PowerACOUSTICS seamlessly integrates into the workflow throughout the product development life cycle. PowerACOUSTICS is a modular application for aeroacoustic post-processing of simulation measurements from PowerFLOW. PowerACOUSTICS is comprised of three modules: a signal processing base module for acoustic analysis; a Noise Transmission Module – an optional module for interior noise prediction; and a Far Field Noise Module – an optional module for community noise prediction.

Interior Noise Transmission Module

PREDICT INTERIOR WIND NOISE
Fully embedded Statistical Energy Analysis [SEA] solver makes it easy to predict noise spectra at occupant's head location generated by exterior wind pressure fluctuations. Fully integrated solution, complete with validated model templates.

SOUND PACKAGE PARAMETER STUDIES
Allows acoustics engineers to rapidly set up glass and cabin properties for interior noise spectra calculations—quantify the effect of changes to glass and interior absorption properties in seconds

GRAPH INTERIOR NOISE SPECTRA
Analyze panel contributions and variation of sound with microphone location

RELIABLE, VALIDATED SOLUTION
Based on extensive validation, PowerACOUSTICS' users may confidently rely on results and proceed with design recommendations to reduce noise levels

The cross plot (below) demonstrates excellent correlation of predicted interior wind noise from PowerACOUSTICS versus experimental results for the 500 to 4000Hz octave bands from 30 test cases.
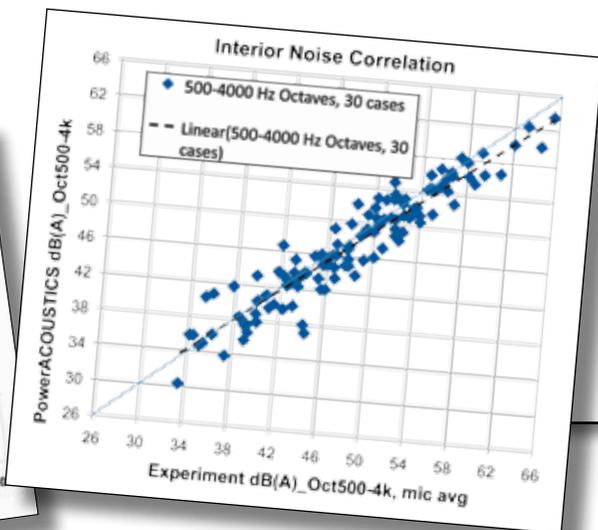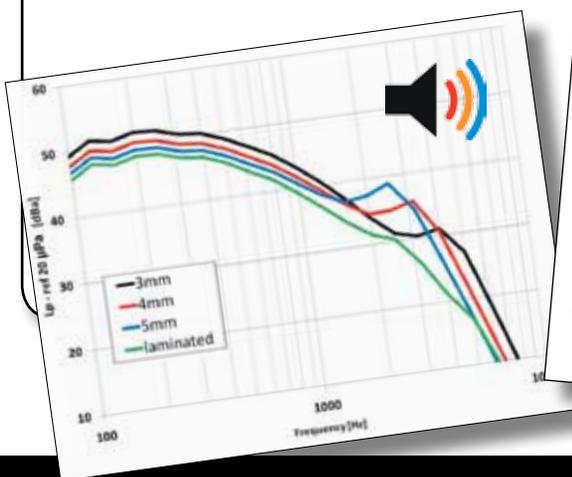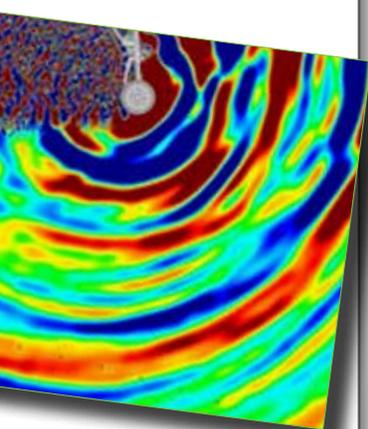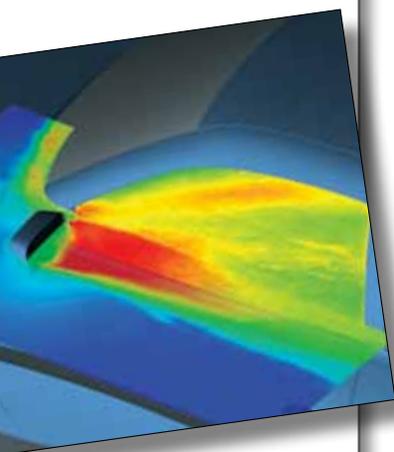
Far-Field Noise Module

ACCURATE TRANSIENT FLOW FLUCTUATION PREDICTION

Leverage PowerFLOW's proven accuracy for the prediction of aerodynamically induced noise: time-unsteady, very low dissipation, and the ability to handle complex detailed geometry.

FULLY COUPLED FAR-FIELD NOISE SOLVER

The fully-integrated Fowcs Williams and Hawkings (FW-H) based solver predicts time signals at receiver/microphone locations based on PowerFLOW transient simulations. Options for fly-over/pass-by vs. wind tunnel scenarios and solid vs. permeable configurations.

SIMULATE THE NOISE ROTATING PARTS GENERATE

PowerFLOW's ability to simulate true rotating geometry coupled with the Far-Field Noise Module, provides an accurate solution for predicting fan and other rotating machinery noise propagation to the far field.

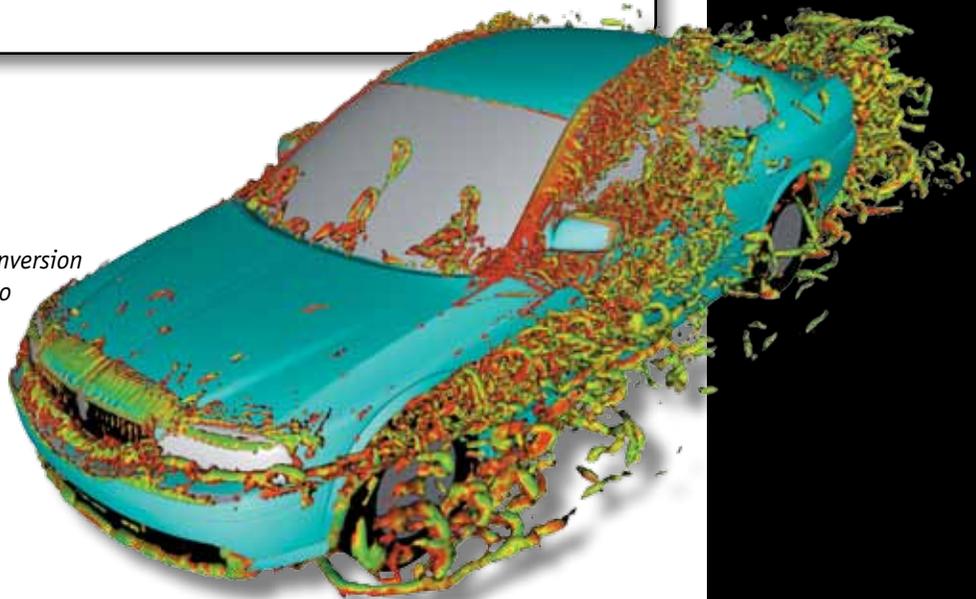### NOISE METRICS AND DIGITAL CERTIFICATION

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. Output far-field signals can be input to inverse methods such as beam forming or acoustic holography providing spatial noise source localizations.

ENLIVEN PRESENTATIONS

With audio signal synthesis, spectrum conversion and sound quality metrics, accurate audio files may be added to presentations to enhance understanding and engineering collaboration