

## PRODUCT INFORMATION

# PULSE™ NVH VEHICLE SIMULATOR



"We can actually drive the NVH Simulator with real context and see whether it's sporty enough or if it's too smooth or too rough. We can drive it against key competitors and evaluate it with customers. And we can do all that before we even make a prototype."

**Mark Clapper, Technical Leader, Vehicle NVH, Ford**

### What is The PULSE NVH Vehicle Simulator?

The PULSE NVH Vehicle Simulator accurately reproduces the noise and vibration of a vehicle in a realistic interactive driving environment. It is used to style and engineer the sound of vehicles to meet brand and customer expectations.

Using the simulator, you sit at a typical vehicle driver interface (steering wheel, pedals, gear shift lever/paddles) and interactively evaluate your NVH data by assessing the sounds and vibrations of the selected car as you "drive" through the virtual scenario. Just as in a real vehicle, the stimuli are determined by user inputs to the controls, and changes in engine rpm, vehicle speed, road surface, and so on.

A range of jury evaluation and engineering interfaces are available to allow assessors and engineers to interact with the NVH data in real-time.

### Typical uses of the PULSE NVH Vehicle Simulator:

#### UNDERSTANDING CUSTOMER PREFERENCES

- Evaluate and rank alternatives (competitors, targets...)
- Capture the decision making process

#### CREATING VEHICLE LEVEL TARGETS

- Modify Sound Quality & Sound Balance
- Prepare possible alternatives

#### CASCADING VEHICLE-LEVEL TARGETS TO SOURCES, SUB-SYSTEMS AND COMPONENTS

- What are the main contributors i.e. where should modifications be made?
- Would modifying them achieve the desired target?

#### EVALUATING PROPOSED ENGINEERING CHANGES

- Measured prototype components from a test bench
- CAE predictions

#### VALIDATION AND SIGN-OFF

- Targets or proposed engineering changes, at the desktop or on-road
- Decision makers & real customers

#### TROUBLESHOOTING

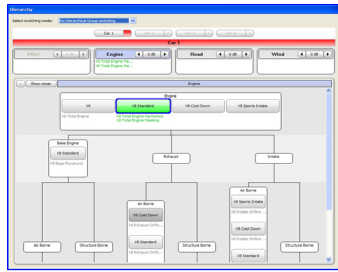
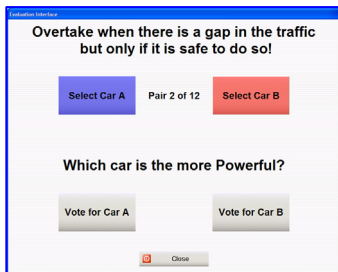
- Rapid identification of root causes and possible solutions

### With the NVH Vehicle Simulator...

- ▶ **Everyone** can make the right judgements about sound and vibration by experiencing physical stimuli, just like when driving a real vehicle.
- ▶ **Decision makers can confidently decide:**
  - does this sound right?
  - will the customer notice?
  - is it worth the cost?
- ▶ **NVH engineers can:**
  - **modify** individual source or component contributions in real time, under any driving condition, for real or virtual vehicles.
  - **assess** sound (and vibration) in an interactive driving environment ... the only way to get correct perception.
  - **gain** a leap in efficiency of data interpretation. The complete driving envelope of a real or virtual vehicle can be evaluated and understood in minutes, rather than the weeks needed to prepare and use graphs or even pre-prepared sounds.



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## Data requirements for the NVH Simulator

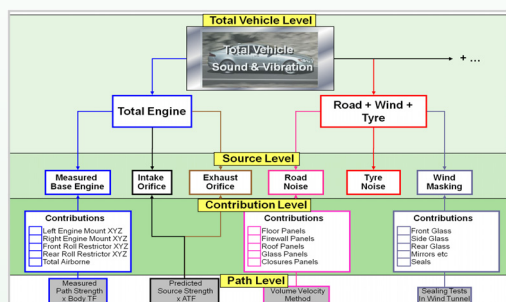
The PULSE NVH Vehicle Simulator uses standard NVH data (time histories, complex spectra, phased orders, transfer functions...)

Vehicles may be simulated at any level in a cascaded representation, from total vehicle down to individual components. The user can decide on the level of detail needed for the current task.

For total vehicle and source level models, existing vehicles can be measured on the road (no need for special facilities) using data recording and preparation tools which have been developed especially for the quick, easy and robust preparation of simulator models.

The data preparation tools support many different file formats so that previously-measured benchmark data can be readily incorporated in new simulator models.

Test or CAE data from path, contribution or other analyses can also easily be included when assembling a detailed vehicle simulation model.



## The NVH Simulator is available in three configurations:

- ▶ The **Desktop NVH Simulator** is for use in an office or laboratory where the NVH Engineer can prepare and work with simulator models. It can be easily transported, for example to a listening or presentation room or to a customer clinic to gather subjective appraisal data in the field.
- ▶ The **On-Road Simulator** allows vehicle sounds created using the Desktop NVH Simulator to be experienced in a real car whilst driving on the road. The sounds of the existing vehicle are modified rather than replaced resulting in a very natural presentation of the target sounds.
- ▶ The **Full Vehicle Simulator** integrates the Desktop NVH Simulator into a fixed donor vehicle to create a complete multi-modal context. This can be provided as a complete turnkey solution, or the required NVH Simulator modules can be integrated into an existing driving simulator to add NVH evaluation capability.

"Our CAE colleagues really like the NVH Simulator. They can use it to experience the real effects of their predicted CAE modifications. This is a key capability in the decision making process."

**Dr. Garry Dunne, Senior Technical Leader, Vehicle NVH, Jaguar Land Rover**

"With the On-road Simulator as a core development tool, the US, Japan and Europe are already sharing road noise models for global benchmarking and target setting. By sharing and comparing data, we can change the global development process and get more accurate results with fewer prototypes"

**David Quinn, Manager of NVH Development, Nissan UK**

## Summary of functionality:

- ▶ Recording of binaural sound (plus tachs, CAN, GPS, & video if required), or multi-channel data
- ▶ Automated data preparation of:
  - NVH data
  - vehicle performance model
  - visual scenario
- ▶ Simple assembly of virtual cars from the prepared data
- ▶ Switching between cars whilst driving
- ▶ Jury evaluation tools to capture and understand the opinions of customers, decision makers and experts:
  - rating
  - paired comparison
  - semantic differential
- ▶ Engineering Tools to manipulate the NVH data for target setting, troubleshooting and design evaluation
- ▶ Real-time spectral analysis
- ▶ Real-time Modification tools to easily change the characteristics of any sound object at any level in the model
- ▶ Contribution creation and modification tools to allow transfer path data (source strength and transfer functions) to be easily incorporated and edited in the simulator model.

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