APPLICATIONS OF NVH DESKTOP SIMULATOR IN VEHICLE DEVELOPMENT PROCESS
(FROM LATE VALIDATION TO EARLY DECISIONS)

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THE NVH TIMING PROBLEM

Physical prototypes

- Arrive late, NVH issues are found when design is almost frozen
- Are expensive

Consistent NVH back -to-back evaluation is limited

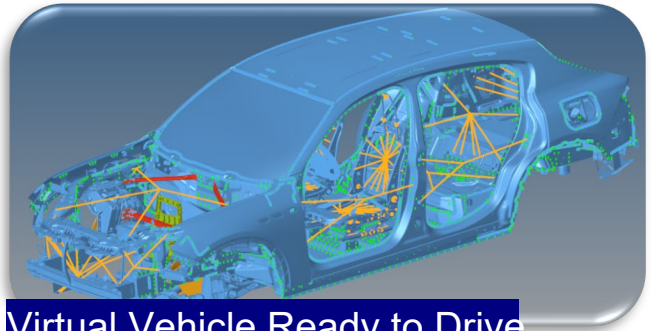
- different vehicles
- different conditions
- short auditory memory

Targets

- become negotiations, instead of clear design inputs
- Objective targets may be not fully aligned with subjective perception

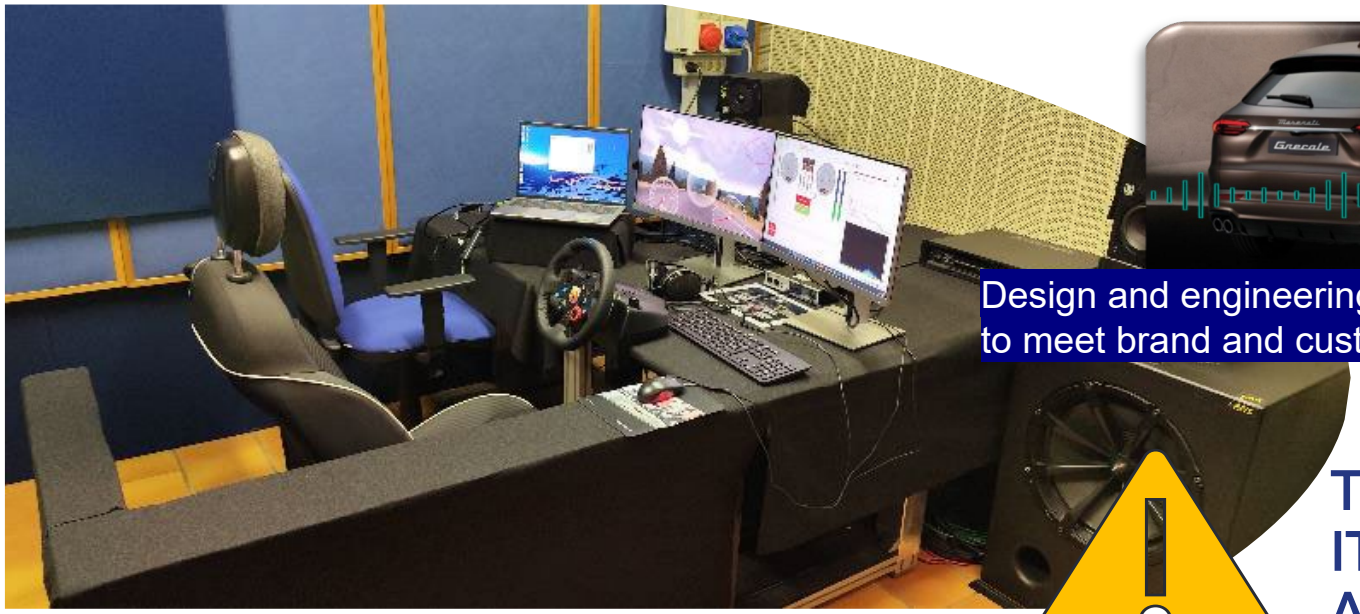
THE NVH SIMULATOR ENABLES EARLY AND INFORMED DECISIONS BEFORE PHYSICAL VEHICLES EXIST

ROLE OF THE NVH SIMULATOR



Virtual Vehicle Ready to Drive

Global Database
(Models sharing between regions)



Design and engineering the sound of new vehicle
to meet brand and customer expectations

Virtual vehicle

- NVH evaluation without waiting for physical prototypes

Record once, playback forever

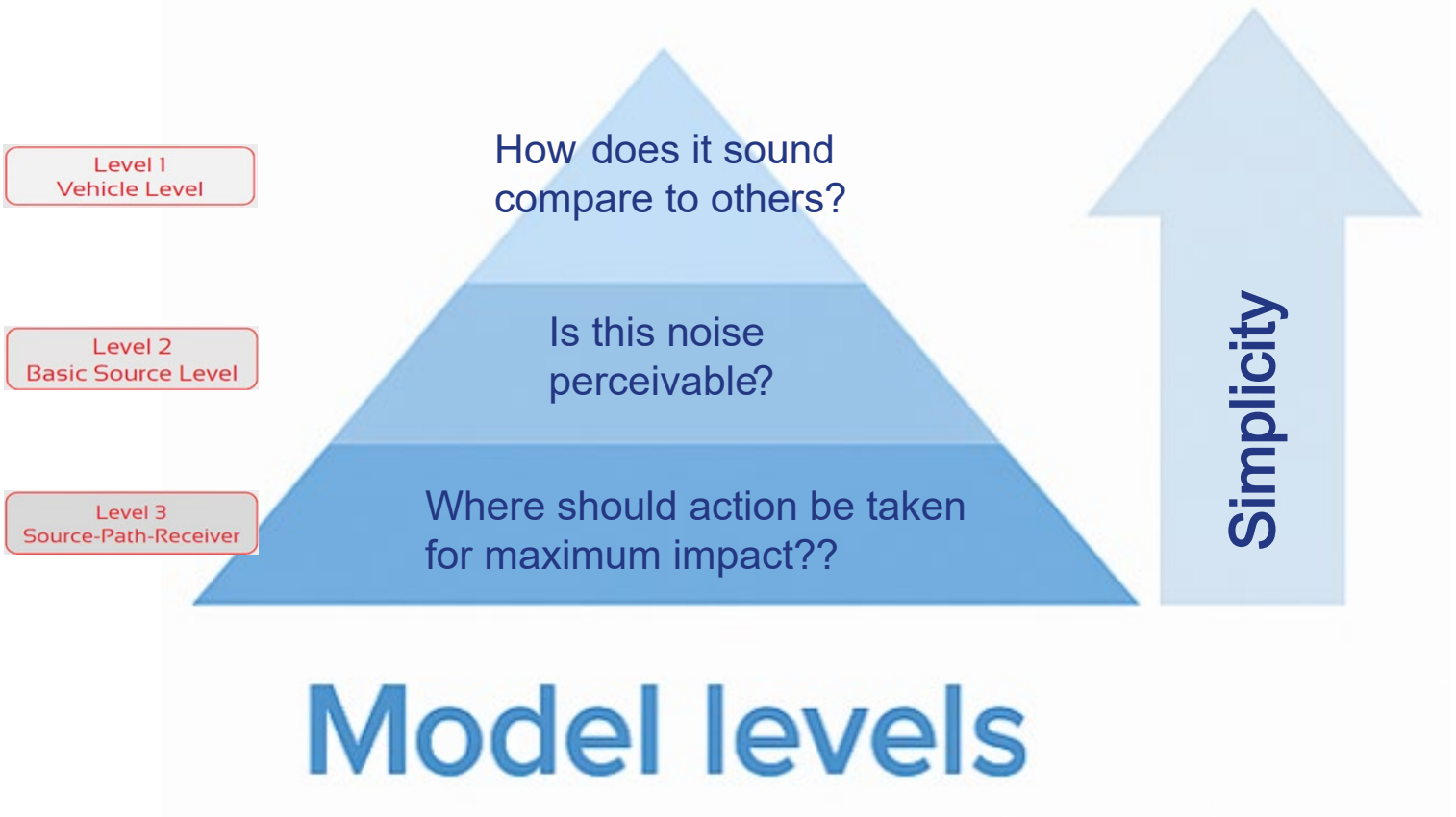
- identical conditions
- true back-to-back comparisons

Early decisions, real savings

- fewer late changes
- reduced time and cost
- It's possible to evaluate Target Sounds

THE SIMULATOR IS NOT JUST AN NVH TOOL, IT IS A HYBRID (VIRTUAL/TEST) PROTOTYPE AVAILABLE IN ADVANCE OF PHYSICAL PROTOTYPES

MODEL LEVELS: FIT THE MODEL TO THE DECISION



Level 1 – Benchmark & Clinics

- based on direct interior noise measurements and are primarily used for benchmarking, subjective alignment across vehicles and Target Design
- Global Database

Level 2 – Masking & Context

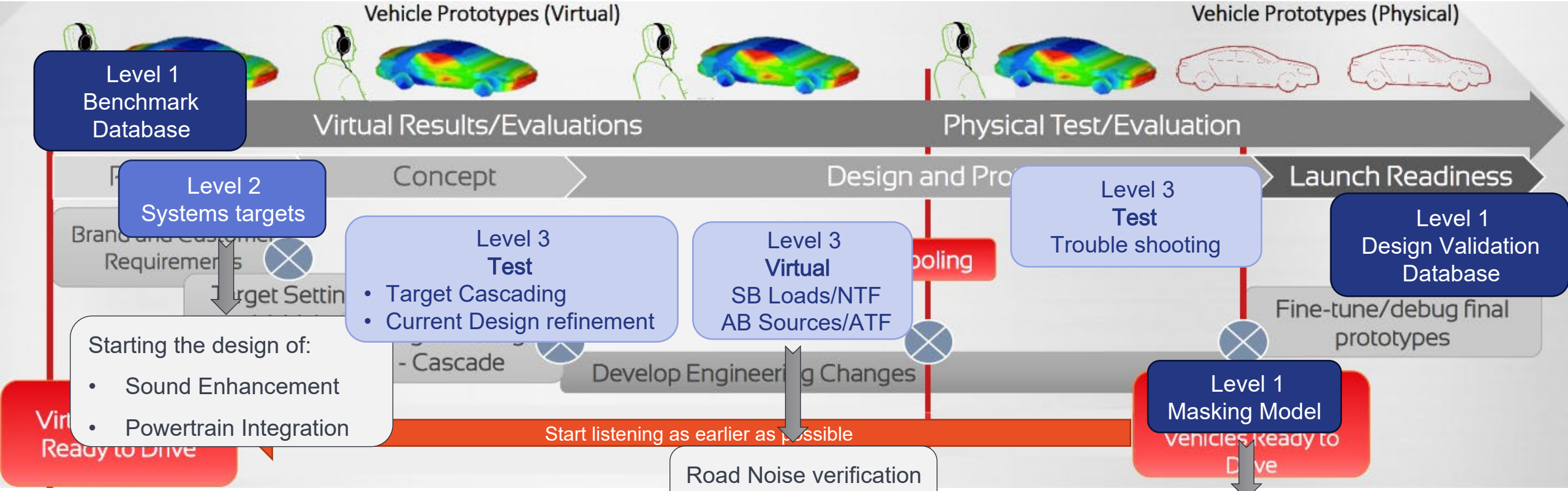
- incorporate road and wind noise to represent masking effects and evaluate noise perception within realistic driving contexts for Sound Enhancement and PWT Integration

Level 3 - Source–Path–Receiver (as Technical Backbone)

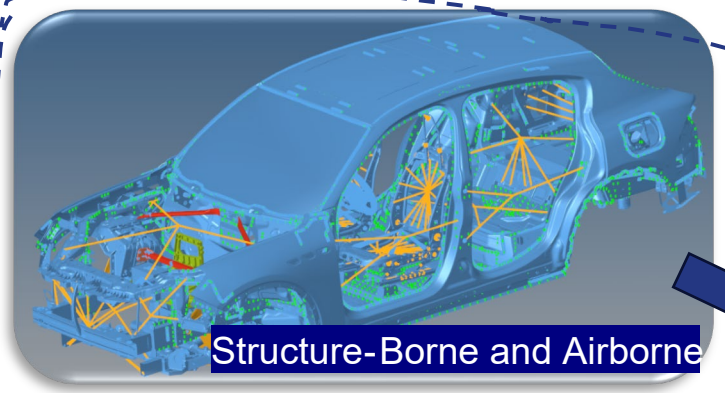
- enables troubleshooting, target cascading, and what-if studies for different designs.

DIFFERENT NVH QUESTIONS REQUIRE DIFFERENT MODELS; THE BEST MODEL IS THE ONE THAT SUPPORTS THE DECISION, NOT THE MOST COMPLEX ONE

WORKFLOW AND NVHSIM MODELS APPLICATION



VIRTUAL VEHICLE FOR EXTERNAL USE



Structure-Borne and Airborne

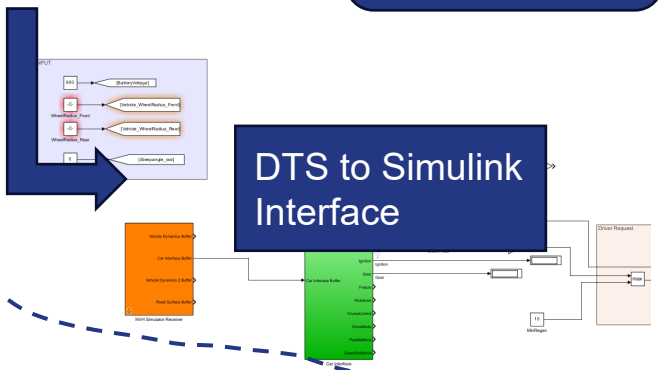
CAN-Bus streaming
- Vehicle Speed
- Front+Rear axles Total Torque
- others

Sound Designer external software

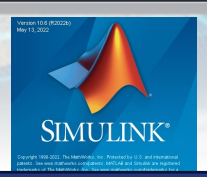
Right rpm profiles for a right playback of orders and additional parameters for external uses

- Throttle
- Brake
- Ignition

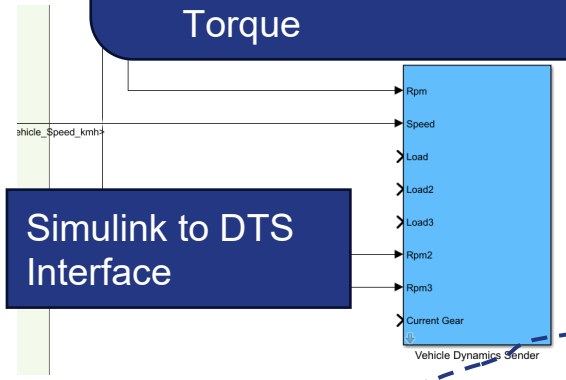
- Front EDM rpm
- Rear EDM rpm
- Vehicle Speed
- Front+Rear axles Total Torque



DTS to Simulink Interface



Simulink Longitudinal Performance Model



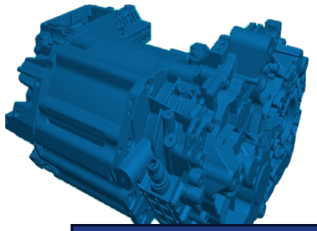
Simulink to DTS Interface

EV AND BEV NVH IS DOMINATED BY TONAL PHENOMENA

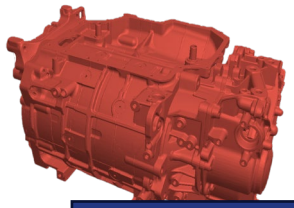
Current eX250

Road+Wind masking

+



Current EDM

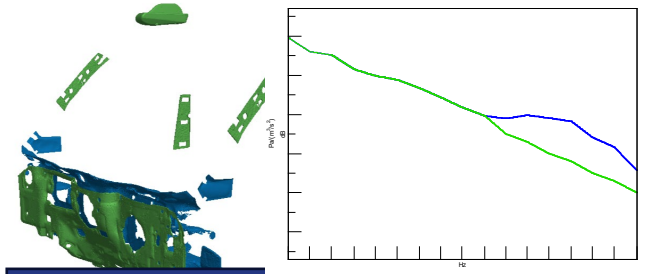


New EDM

Sources (AB only)

+

Current eX250 Noise Insulation



New Acoustic Package

Paths (AB only)

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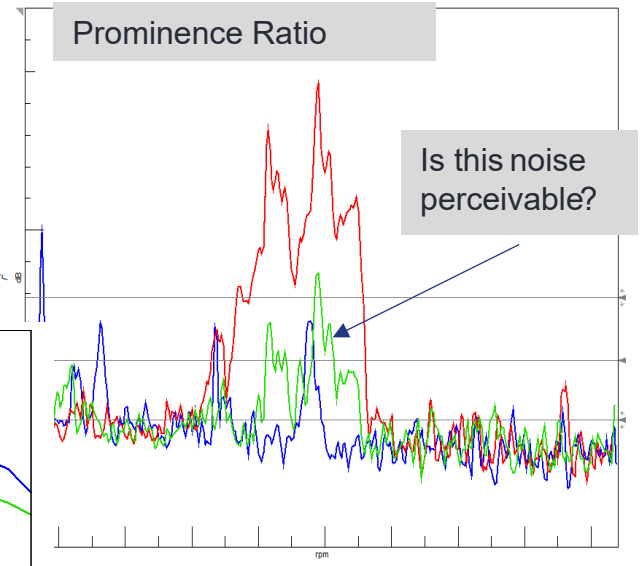


Metric such as prominence ratio is inherently abstract

Masking from road, wind, and auxiliaries drives perceived annoyance of the orders

THE NVH SIMULATOR BRIDGES THE GAP BETWEEN OBJECTIVE METRICS AND SUBJECTIVE PERCEPTION

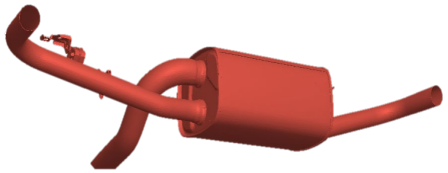
BRAND DNA

Current Stelvio

Road+Wind masking

+

Current Exhaust



New Exhaust

Sources (AB only)

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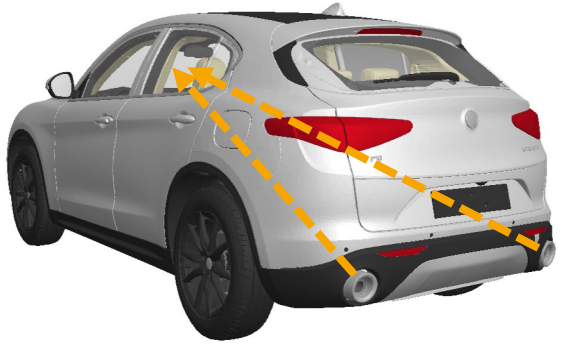

Current Stelvio Noise Insulation

Paths (AB only)

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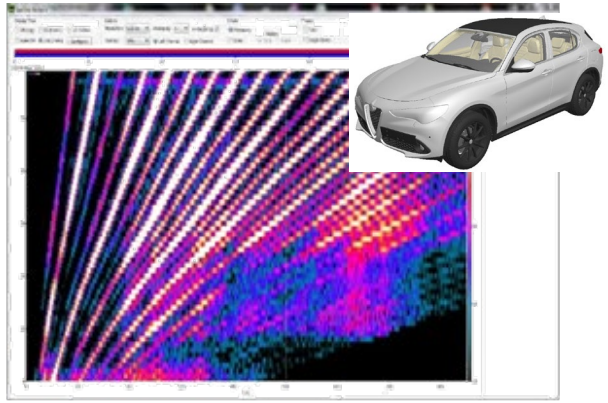
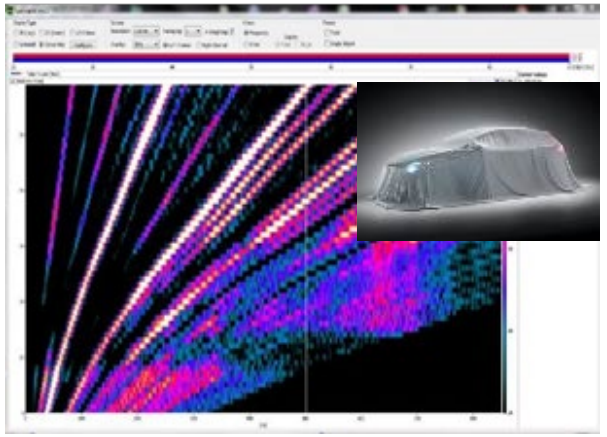


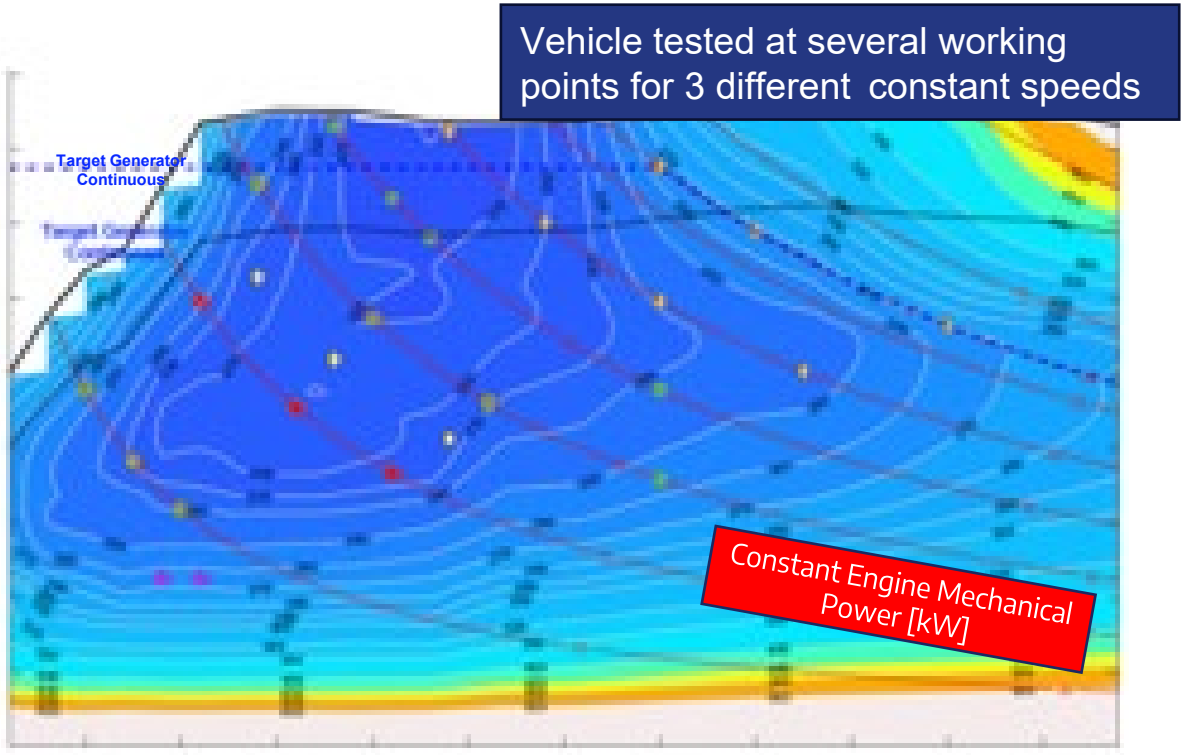


Metric such as spectral maps are inherently abstract

Masking from road, wind, and auxiliaries drives perceived sound quality

THE NVH SIMULATOR BRIDGES THE GAP BETWEEN OBJECTIVE METRICS AND SUBJECTIVE PERCEPTION

REEV PROGRAM TARGET SETTING PROCESS



Use DTS L1 Model to :

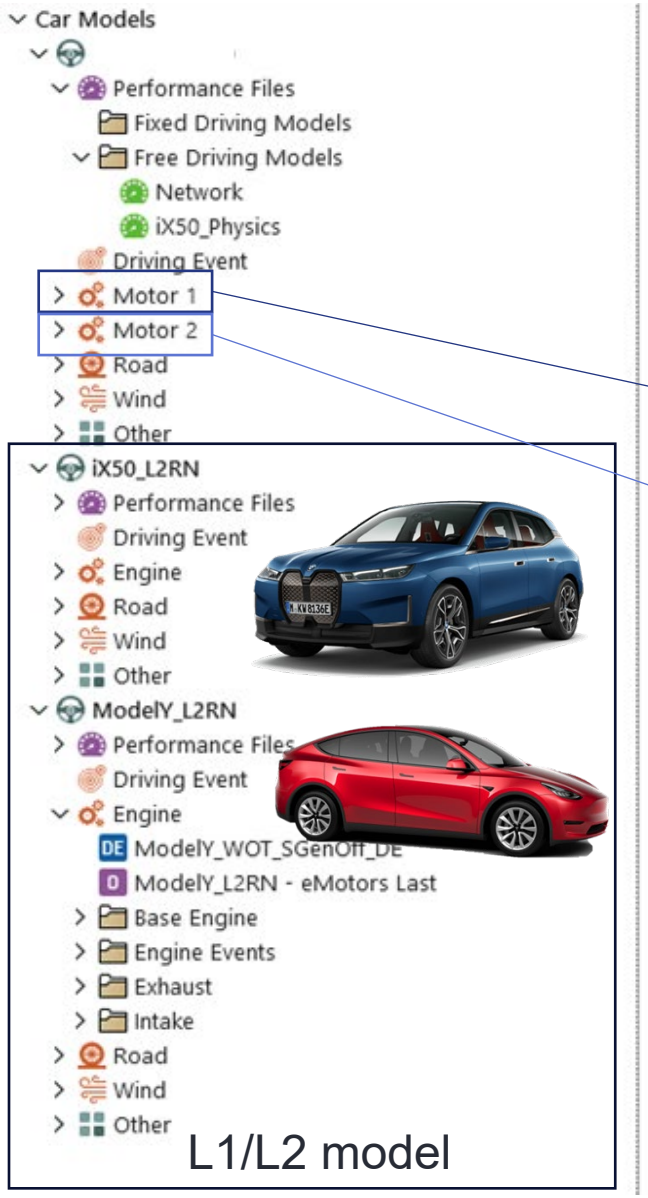
- Determine acceptable driver's ear engine noise levels for worst case driving scenarios
- Subjective Jury Evaluations
- Objective comparisons to current powertrain

Use DTS L3 Model to :

- Derive system level targets to meet driver's ear response
- Manipulate exhaust, engine & AIS source noise levels to simulate source level improvements
- Manipulate acoustic transfer paths to simulate effects of improved acoustic package

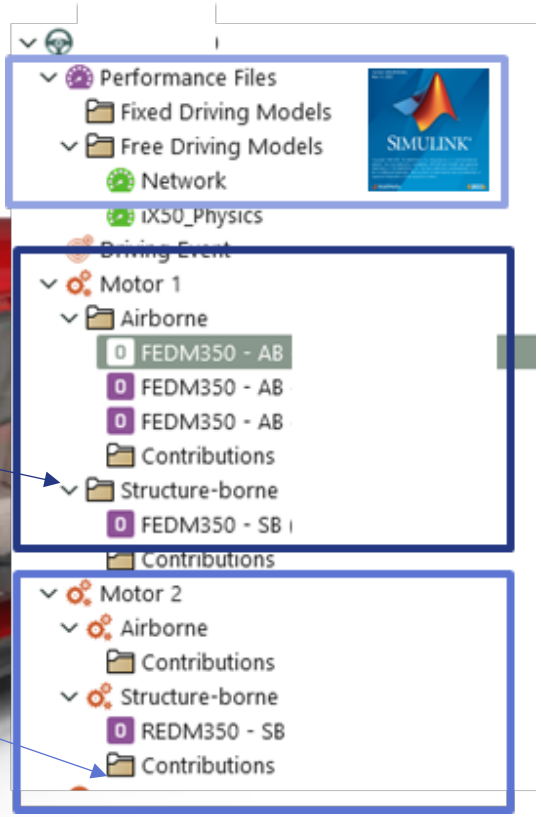
THE NVH SIMULATOR UNLOCKS VEHICLE TEST SCENARIOS THAT ARE IMPOSSIBLE TO TEST ON REAL VEHICLES

NEW BEV VEHICLE



Use CAE Auditioner

- FEM/Test Loads/Sources (Sweeps)
- FEM NTFs/ATFs



CONCLUSIONS & NEW DEVELOPMENTS

Final messages

- NVH performance can no longer rely on late physical prototypes alone.
- The NVH simulator enables early, customer-focused decision making across the V-Model.
- Decomposing NVH into Source–Path–Receiver makes noise issues actionable and controllable.
- Virtual NVH evaluation supports prototypes reduction, cost control, and faster convergence.

New developments

- Increased automation of NVH model build and updates (reduced turnaround time for virtual loops).
- Improved realism in free-driving NVH evaluations with high-fidelity powertrain and vehicle dynamics models.
- Enhanced immersion through advanced audio (spatial sound) and integration of the vibrations.

CONTACT

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