

VIBES.technology
engineering good vibrations

# HYBRID MODULAR ENGINEERING

Combining experimental and numerical data into one accurate assembly model

# **FUSE TEST AND SIMULATION** WITH HYBRID MODULAR ENGINEERING

Hybrid Modular Engineering combines experimental and numerical data to analyze complex structures by breaking them down into smaller, manageable substructures. Using this, the most accurate assembly model can be obtained in any stage of product development, allowing you to modify substructures and assess the impact on the noise & vibration behavior of assemblies.

*“With VIBES software, our engineers have reduced the number of prototype cycles by 40%.”*

- VIBES customer, **NVH manager at a German OEM** -

# COMMON CHALLENGES

## How to make accurate NVH predictions for products that don't exist yet?

Before a prototype exists, NVH can only be predicted with CAE, and pure CAE loses accuracy above a few hundred Hertz. Hybrid Modular Engineering assembles test-based and numerical component models, keeping predictions within 1–2 dB of measured results into the kHz range.

## How to combine test data with CAE models?

CAE packages can't include measured component models in their simulations, so teams usually fall back on custom scripts. Hybrid Modular Engineering couples test-based and numerical models directly, so measured components can sit alongside simulated ones in one assembly.

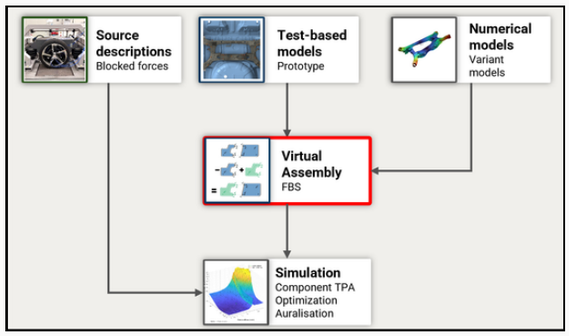
## How to know which available design parameters influence the NVH result?

It's often unclear how each design parameter affects the NVH result, or how changing one shifts the problem elsewhere. Variant studies let engineers compare design options in a fully coupled assembly, showing which changes move the result toward target.

## How to work with a limited number of design parameters in NVH?

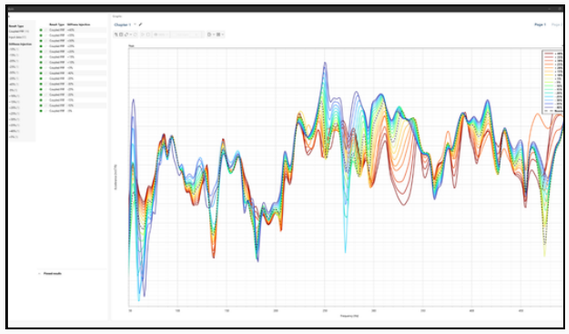
NVH work often has only a few parameters to adjust, which leaves little room to reach the target. Hybrid Modular Engineering however lets engineers swap components, vary mount stiffness and adjust mass or modal properties across many variants.

# THE WORKFLOWS



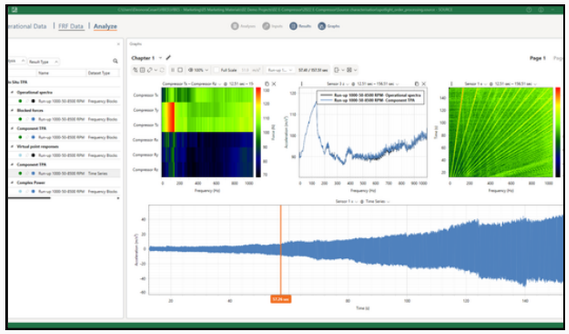

## FREQUENCY-BASED SUBSTRUCTURING

Frequency-based substructuring assembles component models into a full system: test-based models, numerical models from CAE and parameterized stiffness or mass models, all coupled at their interfaces. Engineers can then predict the assembly's NVH behavior and swap components without building a physical prototype.



## STRUCTURAL MODIFICATION

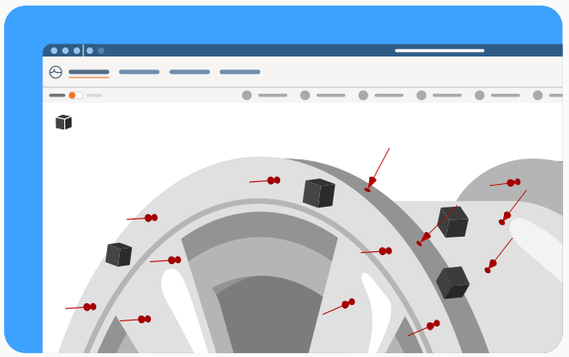
Structural modification predicts how a change to one component, such as stiffening a mount or modifying a subframe, affects the noise and vibration of the whole assembly. Engineers can evaluate design changes based on the real dynamic coupling between components, without having to rebuild the assembly for each variant.



## LIVE SOUND SYNTHESIS

Sound synthesis converts predicted responses to the time domain so engineers can listen to the result at a target location, such as the driver's ear. Design variants can be compared by sound as well as by spectra, before a prototype exists.

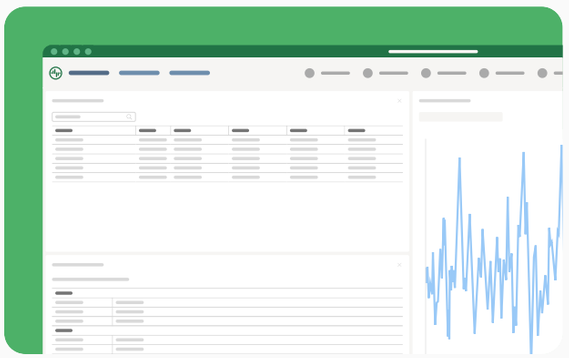
# INSIDE THE SOLUTIONS



## DIRAC

**MEASURE**

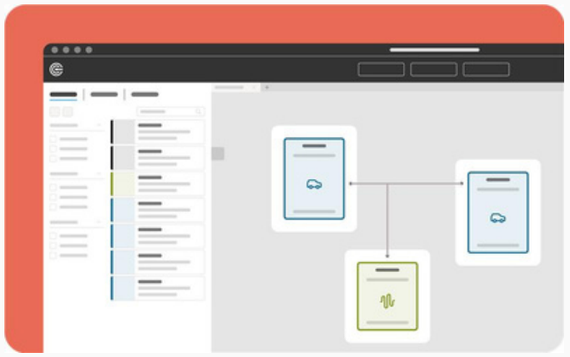
**DIRAC** is VIBES user-friendly FRF testing software with Virtual Point Transformation technology. It enables engineers to measure FRFs of components and full-vehicles and to use the resulting models in many different configurations or for Blocked Force calculations.



## SOURCE

**CHARACTERIZE**

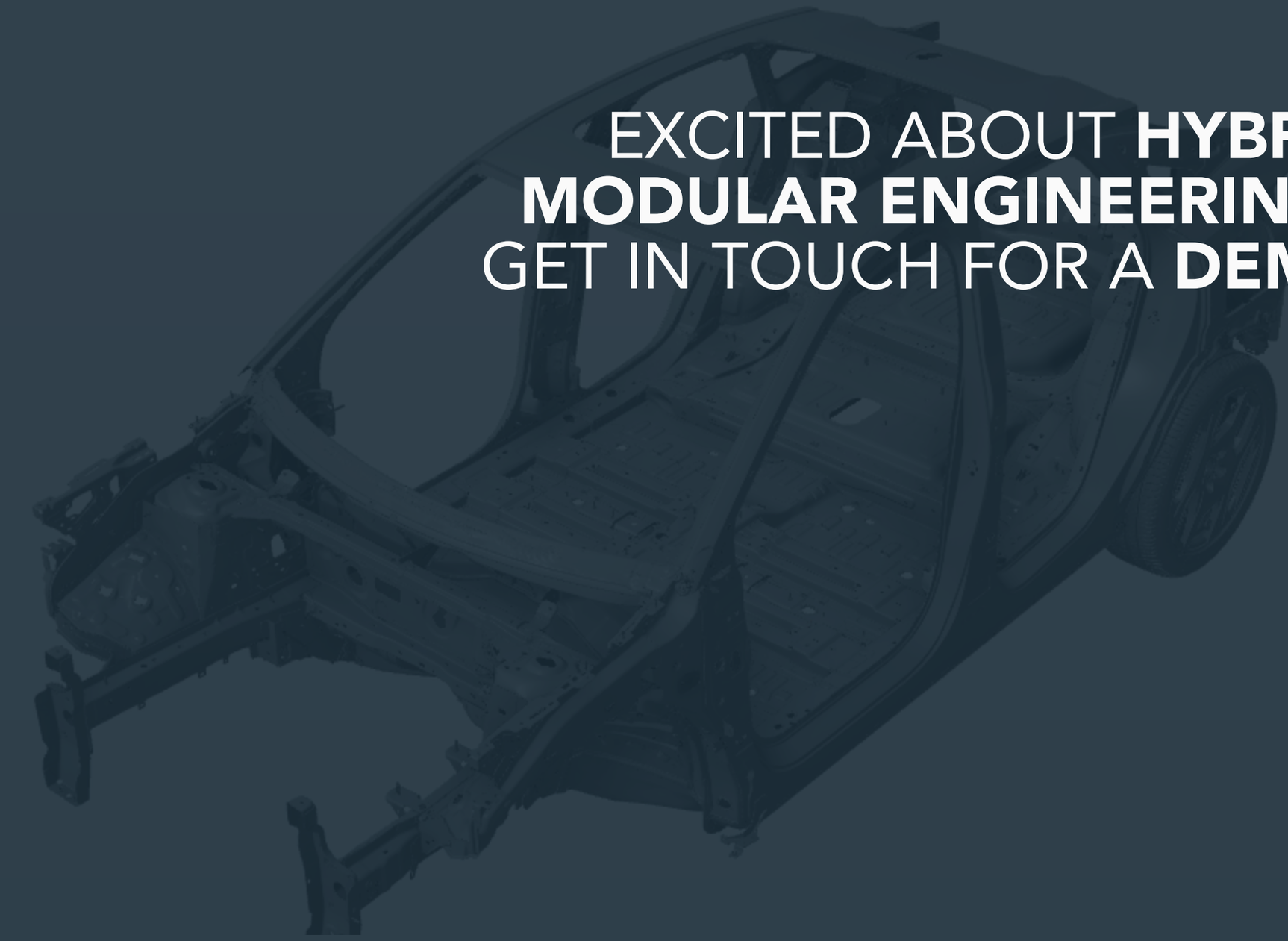
**SOURCE** is a dedicated software application for Blocked Force source characterization and component TPA. It generates high-quality and traceable calculations, an intuitive workflow and multi-leveled quality checks.



## COUPLE

**ASSEMBLE & PREDICT**

**COUPLE** offers you a modular NVH approach where you can easily combine test-based models with models from simulations. Assemble, predict and optimize your NVH design.



# EXCITED ABOUT **HYBRID MODULAR ENGINEERING?** GET IN TOUCH FOR A **DEMO**

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