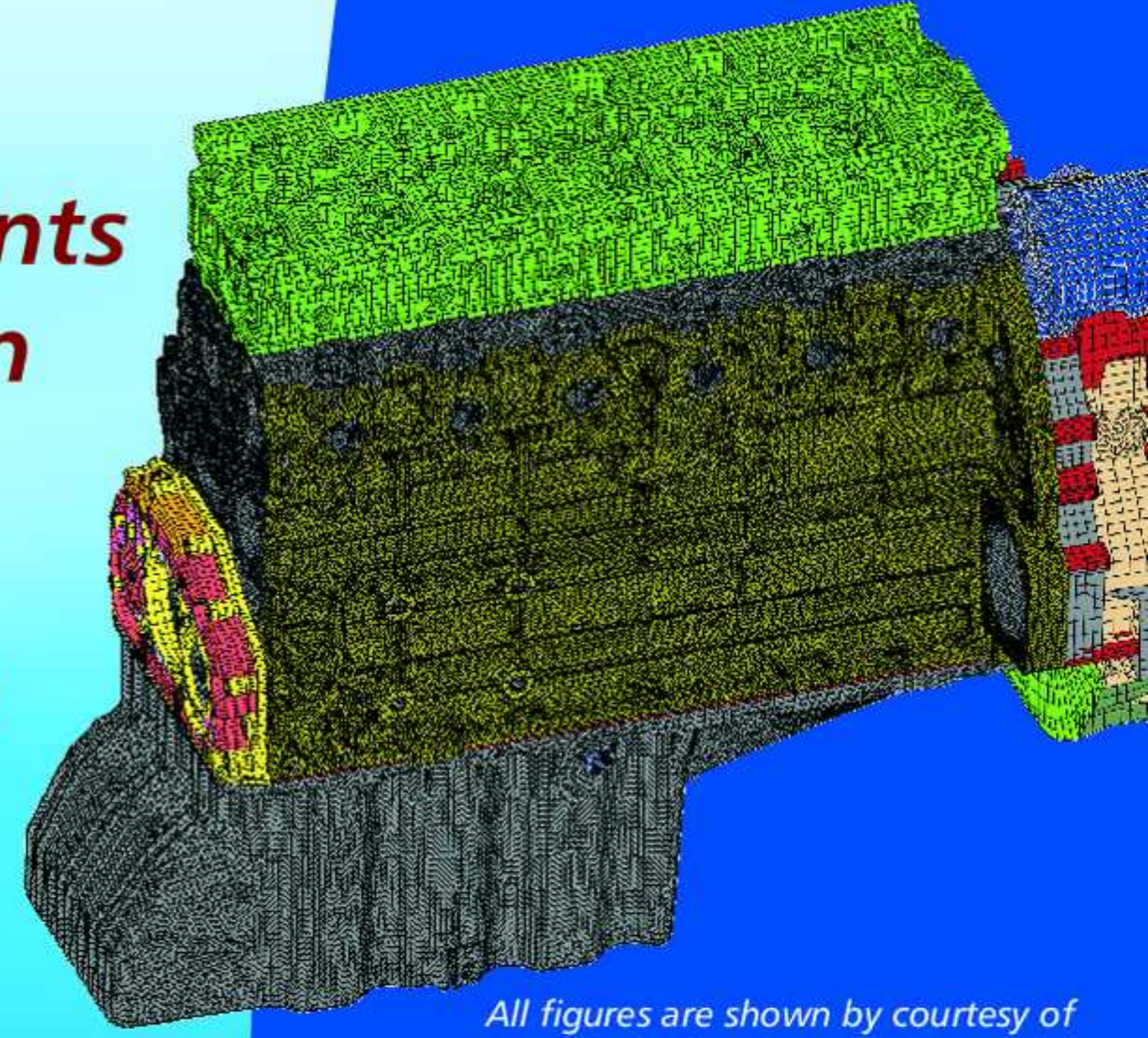# PERMAS

Acoustic Powertrain Analysis

Engine model with attached parts:
- **Structure-borne noise at interface points**
- **Assessment of airborne noise emission through surface velocities**
- **Oilpan with oil**
- **Wide frequency range (>1000 modes)**
- **High number of dynamic load cases**
- **Very large models (>4 million nodes)**

All figures are shown by courtesy of DaimlerChrysler AG, Commercial Vehicle Division in Stuttgart
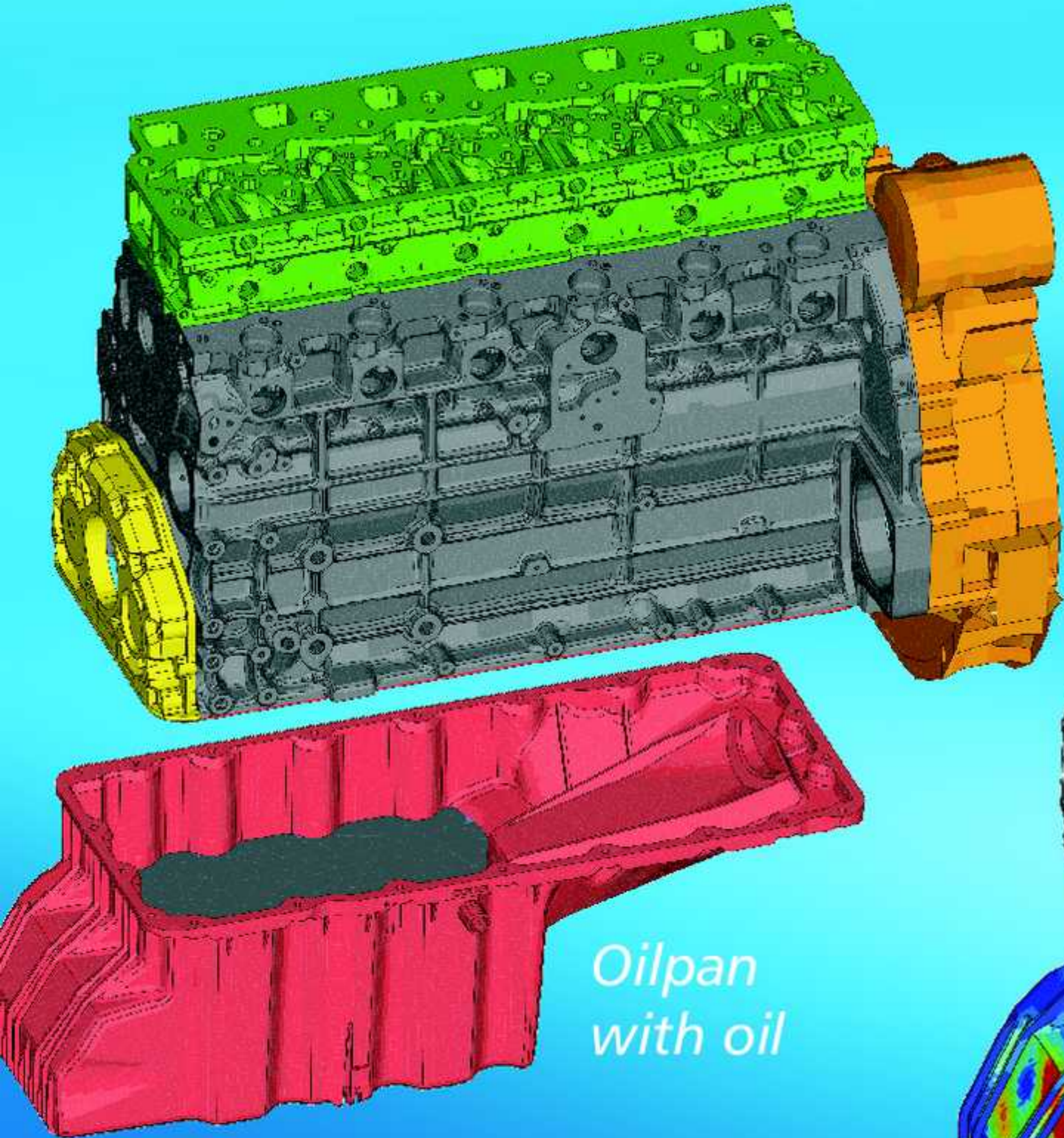
Oilpan with oil
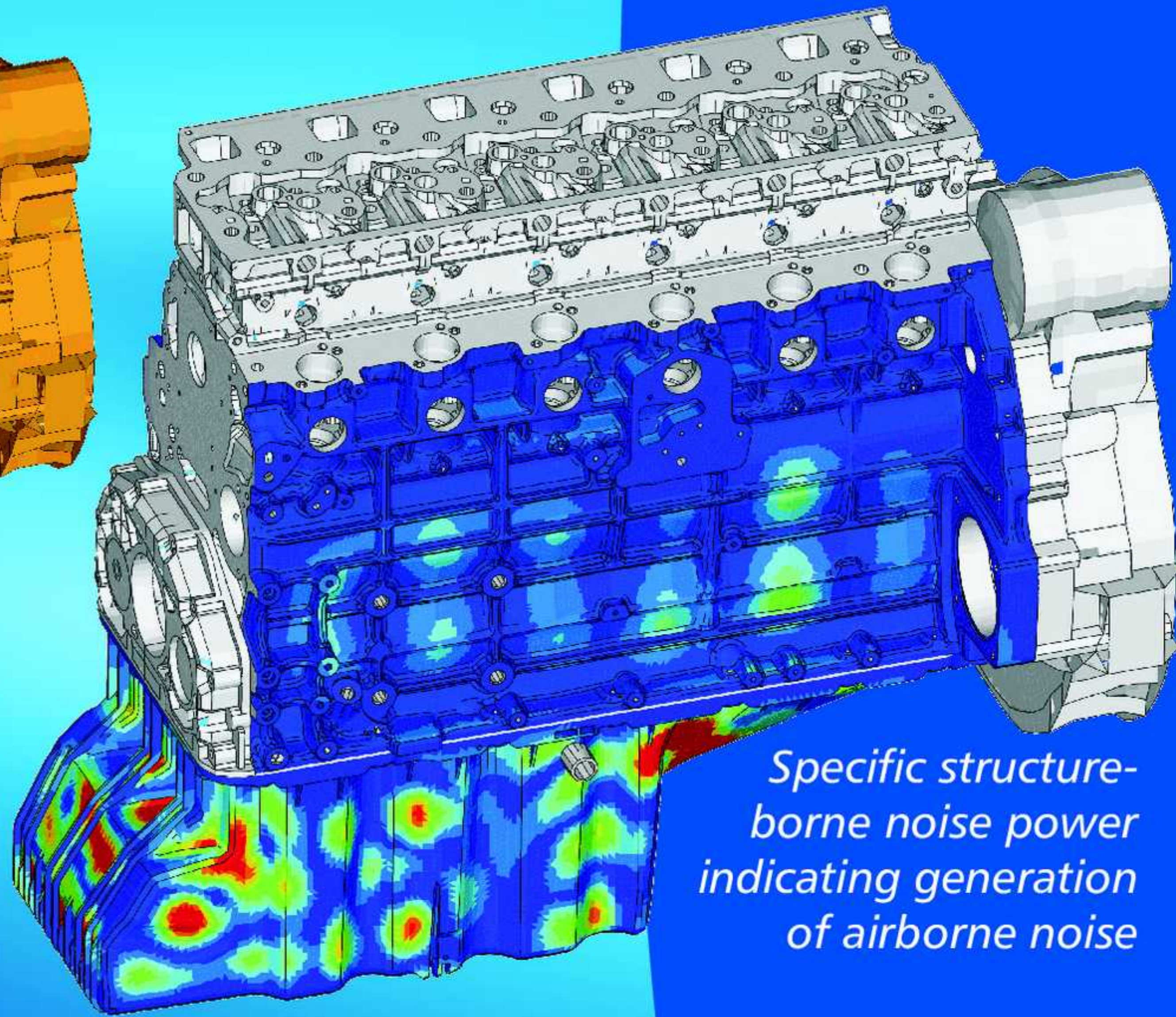
Specific structure-borne noise power indicating generation of airborne noise

Dynamic substructuring:
- **Highly efficient eigenvalue analysis with MLDR (Multi-Level Dynamic Reduction)**
- **Dynamic Condensation (Craig-Bampton)**
- **MLDR with reduced substructures and for coupled fluid-structure models**
- **Dry condensation of oilpan with oil**
- **Short run times using parallelisation**

Attached parts provide realistic boundary conditions
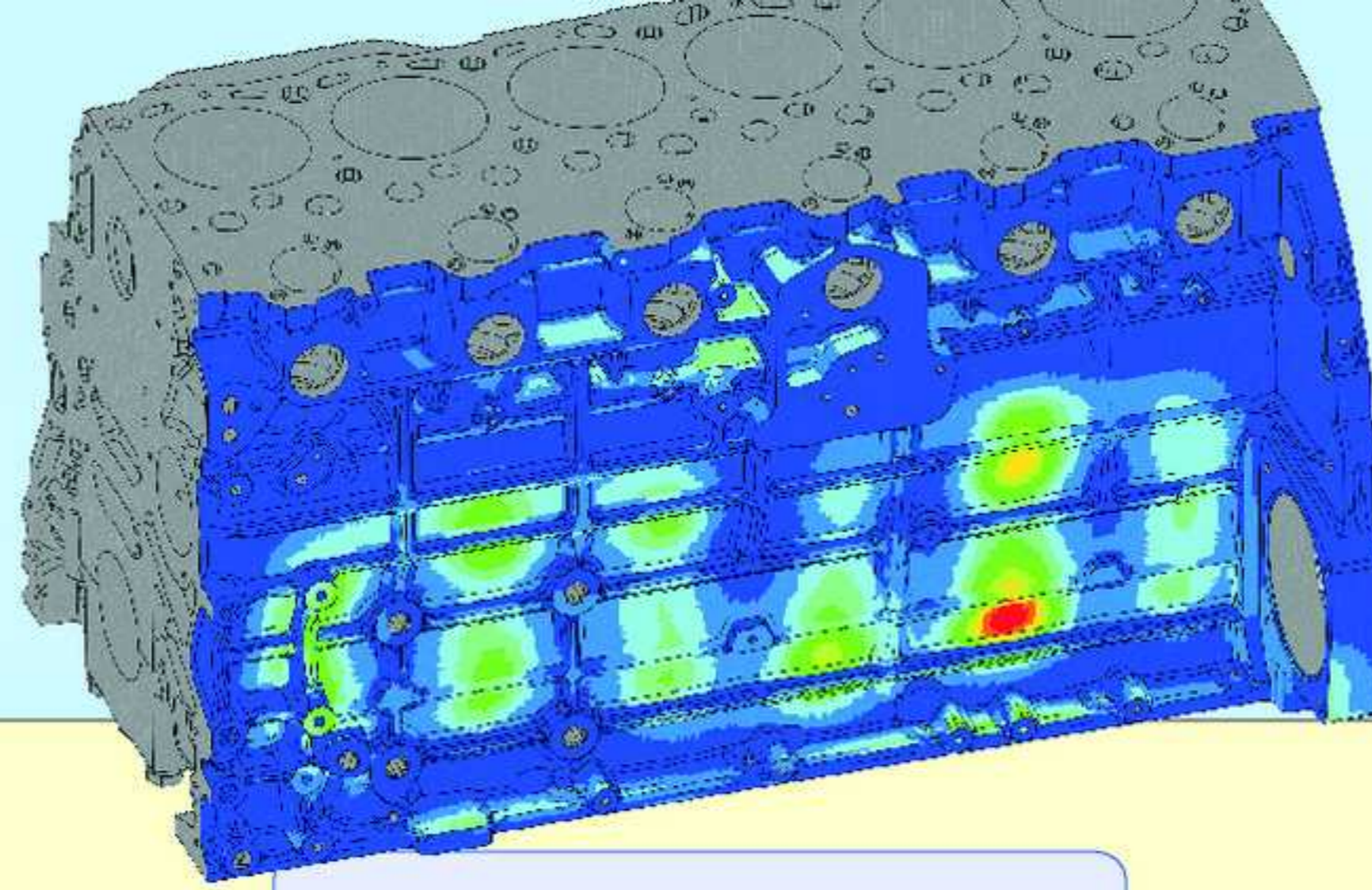
Computation of the specific structure-borne noise power of the crankcase including the reduced attached parts
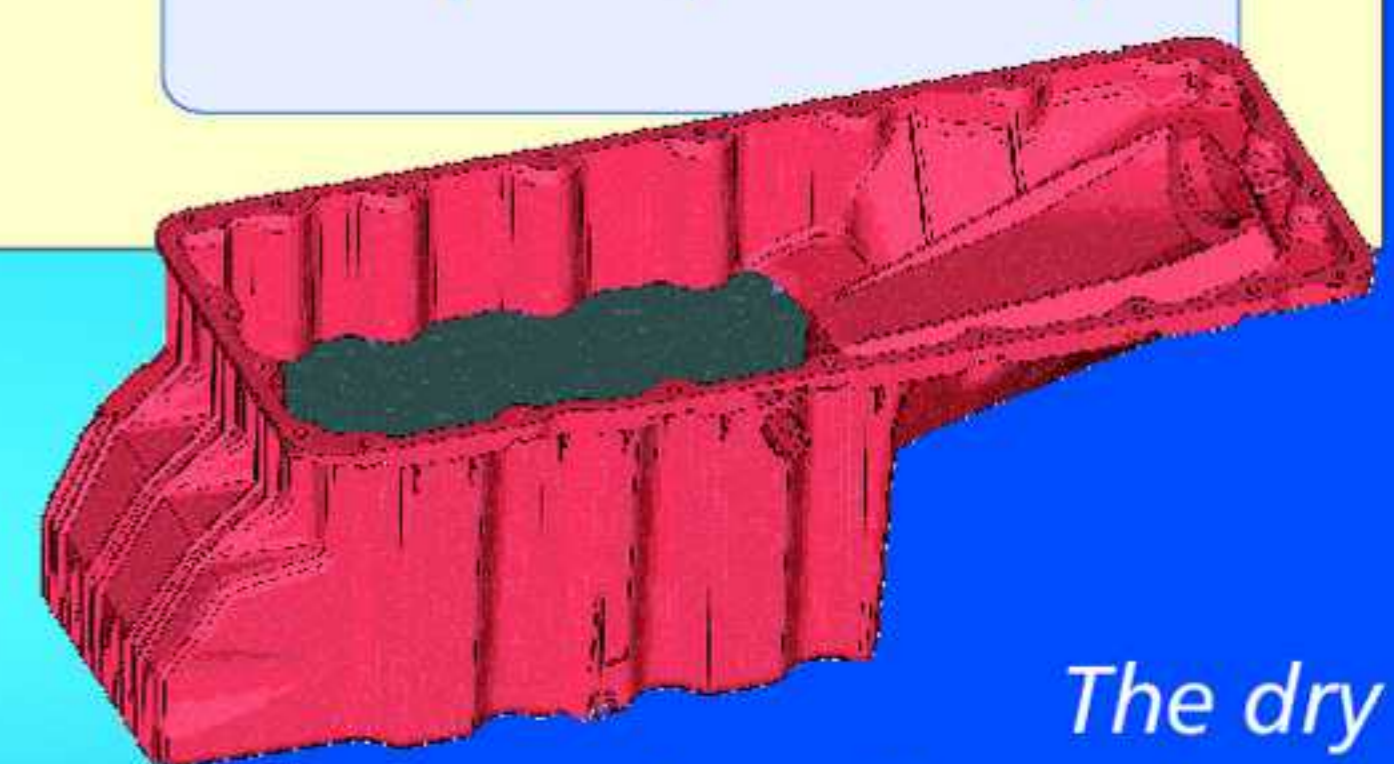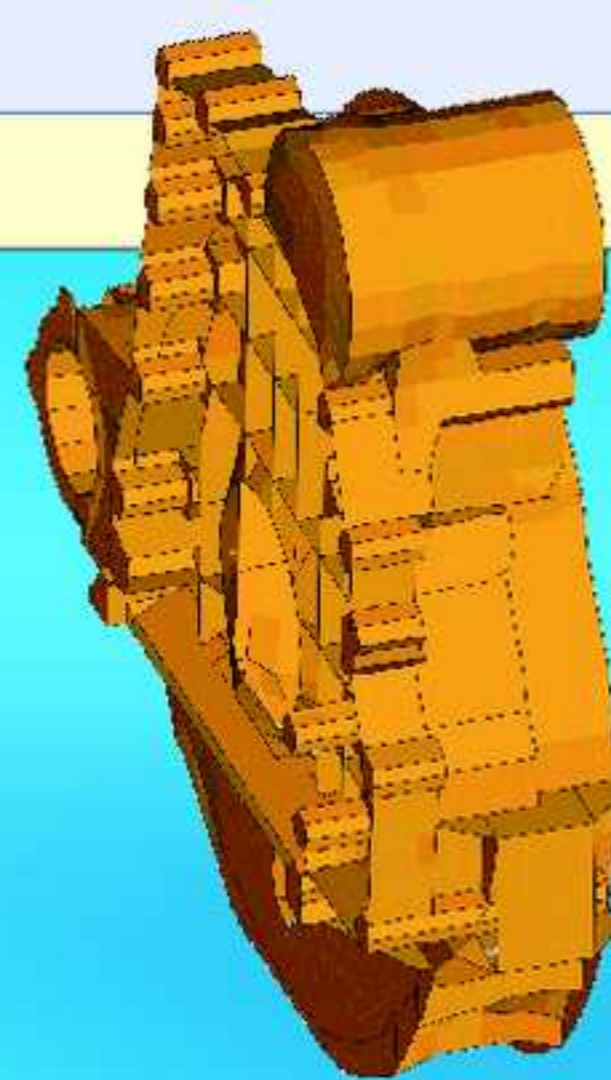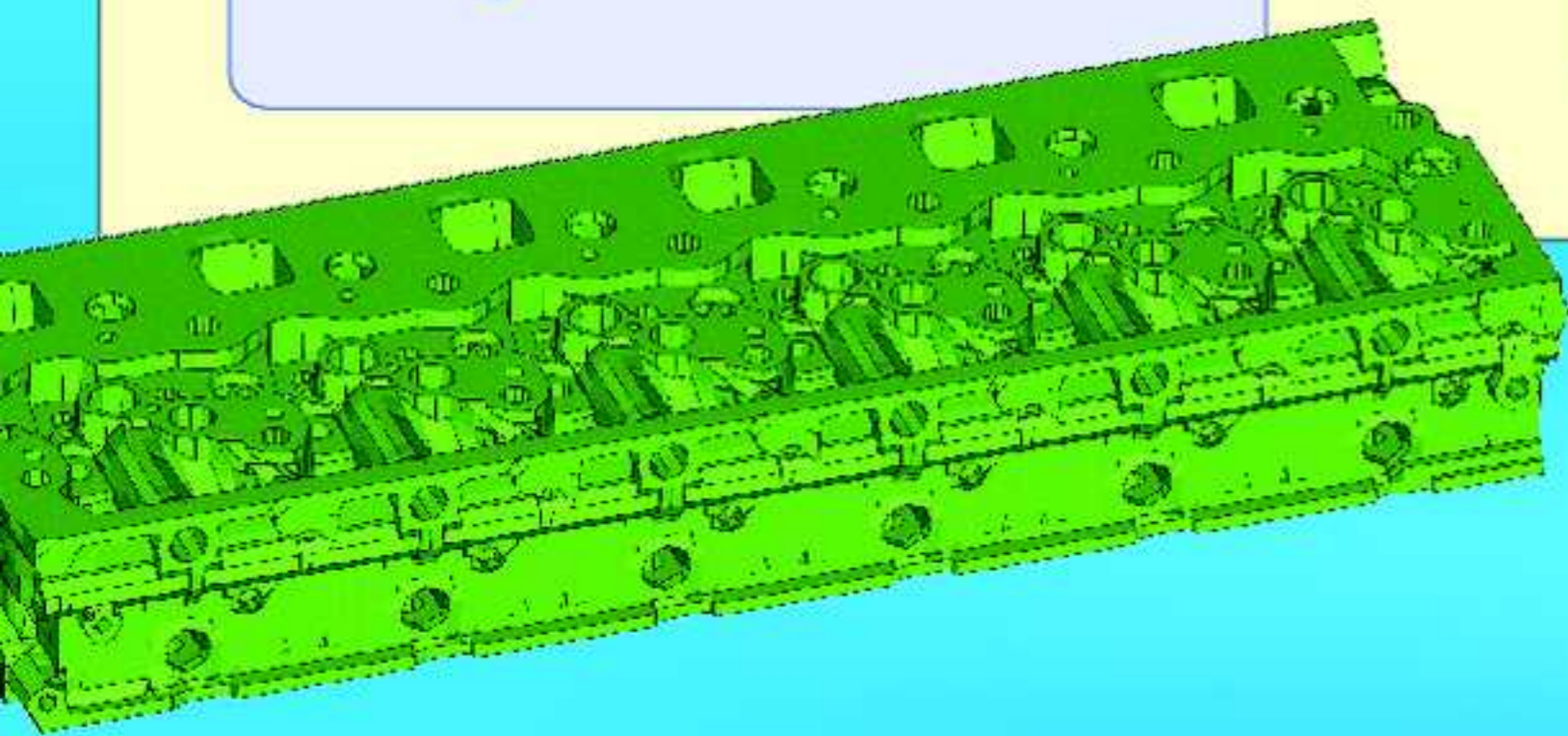
Kit with reduced substructures

Instead of the crankcase e.g. the oilpan can be analysed using the other parts

Crankcase

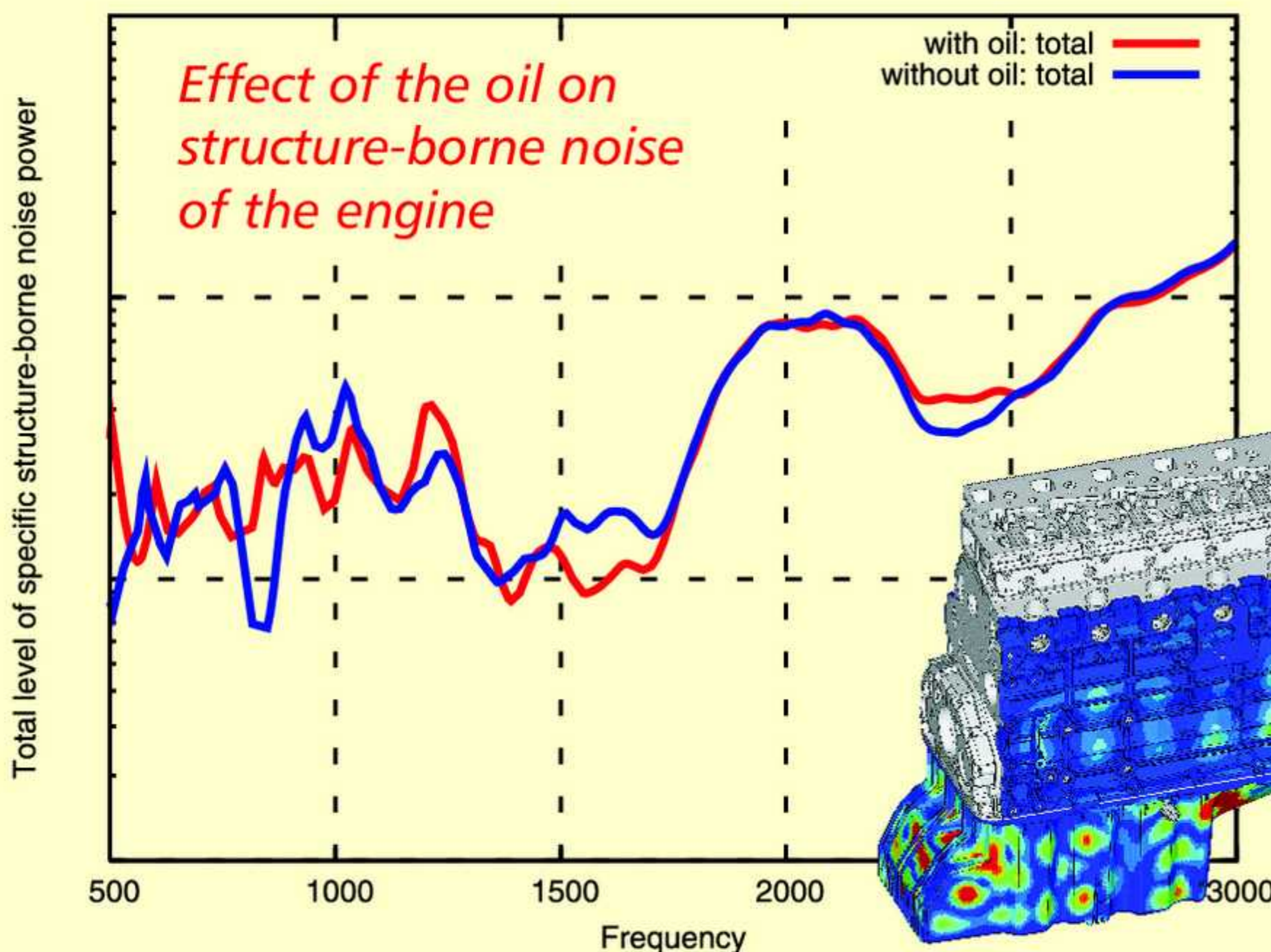with reduced attached parts

Cylinder head

Timing case

Oilpan (with oil)

The dry condensation reduces a fully coupled fluid-structure model to only structural degrees of freedom

More powertrain analyses:
- **Nonlinear static analysis**
- **Nonlinear and transient heat transfer**
- **Heat transfer coupled to stress analysis**

Effect of the oil on structure-borne noise of the engine

with oil: total
without oil: total

Total level of specific structure-borne noise power

Frequency

500   1000   1500   2000   3000