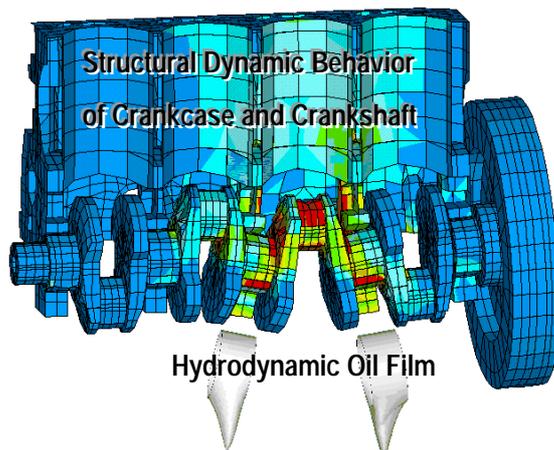


Powertrain NVH Development Structural NVH Optimization

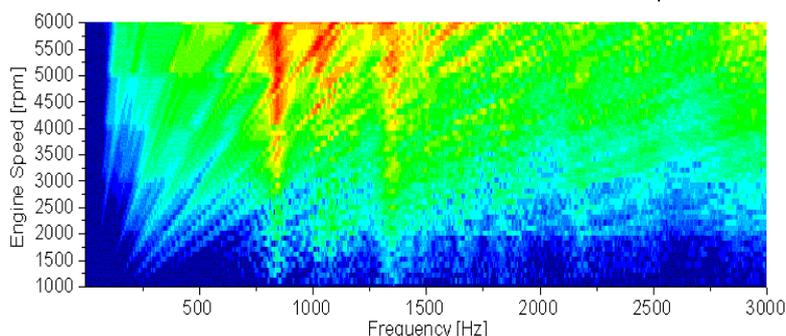
The powertrain is a very important component of the vehicle, especially regarding customer expectations. Besides power and torque, the NVH behavior (sound & vibration) characterizes the quality of the powertrain and the vehicle respectively.

CAE tools can be used in two design stages, dependent on the customer needs. In the **early design stages** of a new engine family, CAE support, in combination with scatter bands, is used to quickly and inexpensively generate a first prototype, representing the most advanced state of development possible.



By ensuring the initial prototype is very advanced, the development time for a new engine family can be reduced significantly. If hardware is already available and **problems have occurred**, the CAE tools can be used to understand the problem and find the optimal solution under given boundary conditions.

The powertrain is excited by several **excitations mechanisms**: combustion, valve train, piston slap, injection and



Campbell Diagram of a Simulated Engine Speed-Up

■ Structural NVH Optimization and Comparison with the State-of-the-Art

- Engine block and cylinder head
- Oilpan and covers
- Gearbox
- Powertrain assembly
- Powertrain bending

■ Block/Crankshaft Interaction

■ Investigation of Excitation Mechanisms

- Combustion
- Valve train
- Piston slap
- Injection system
- Chain, belt and gear drive

accessory drive. These excitations can be either used from an existing database, or calculated/measured for the specific application. Once the excitation is applied to the structure, the acoustic behavior of the powertrain or single components can be evaluated and optimized.

The **bottom-end design** of the crankcase influences the acoustic behavior of the powertrain significantly. The actual combustion excitation can be applied for the whole engine speed range considering the influence of the flexible crankshaft and the hydrodynamic oil film. Different crankshaft materials, clearances, bottom-end designs, damper etc. can be analyzed regarding the influence on noise and vibration of the powertrain.

FEV has fast and efficient, as well as precise and sophisticated tools available to support the powertrain development and achieve an outstanding NVH behavior.

CONTACT: Dr.-Ing. Norbert Alt
FEV Motorentechnik
Neuenhofstraße 181
52078 Aachen, Germany
Phone: +49 (0)241 5689-419
Fax: +49 (0)241 5689-119
E-Mail: alt@fev.de
Internet: <http://www.fev.com>