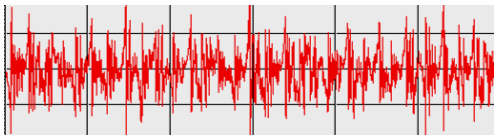
Virtual Engineering …

… Engineering Services for Automotive Applications

Computer Simulation of Complete Powertrains and Drivelines in VEHICLES (Cars, Trucks, Construction & Agricultural Vehicles, Special Vehicles)

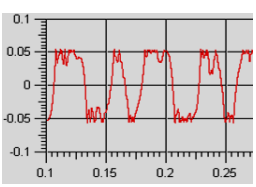
Customer-Dedicated Engineering Services to Optimize the NVH Behavior of Complete Powertrains & Drivelines

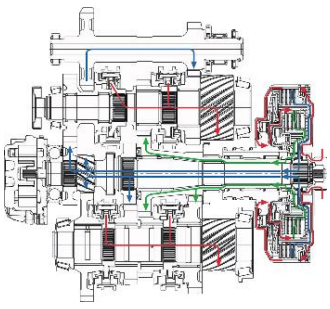
Application and Distribution of User-Friendly Software for PCs (Windows 10 and later)

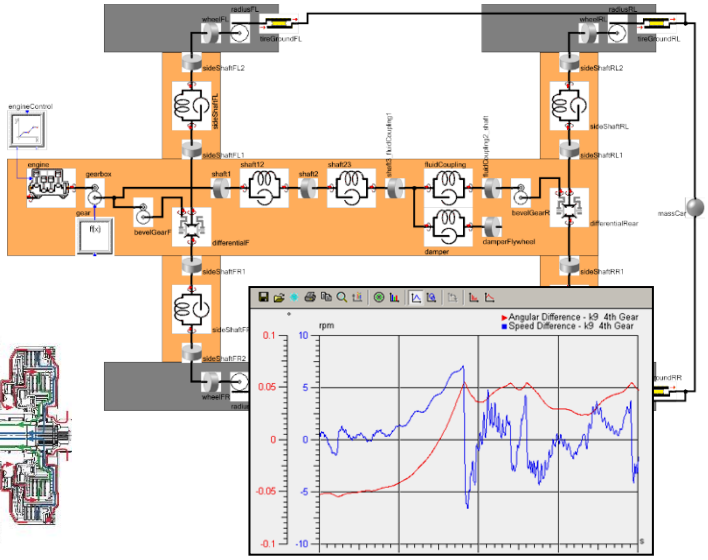


Dr.-Ing. Andreas Laschet is specialist in computer simulation technology. Due to longterm experiences in the simulation of complete drive systems and powertrains, I offer a professional customer **CAE Service for Engineers** worldwide including consultation, analysis, and computer simulation concerning the **DYNAMICS IN AUTOMOTIVE POWERTRAINS & DRIVELINES**. My customers are well-known OEMs including the suppliers.

All these CAE jobs contain a practice related consultation in an early product development stage (i.e. advanced engineering as part of a "**Virtual Engineering**" strategy) on the one hand, but also a quick engineering support in case of any current problems ("**Troubleshooting**") on the other hand. My CAE services have proven to be successful during the last 40 years while working out proposals and solutions to optimize the **NVH Behavior of Automotive Powertrains & Drivelines**. In particular the extended analysis of torsional vibrations in connection with other dynamic effects is one of my key engineering jobs to improve the system behavior. This does also include the evaluation of acoustic effects (e.g. gear rattling or impacts due to torque reversals) considering special NVH rating functions (i.e. **NVH Sensitivity Evaluation**). This allows to systematically compare various drive concepts (like FWD, RWD, 4WD, AWD, hybrid configurations, BEV concepts, etc.).







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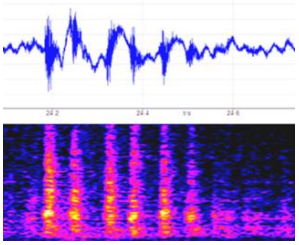
Virtual Engineering for Automotive Applications

NVH Engineering for the Automotive Industry …

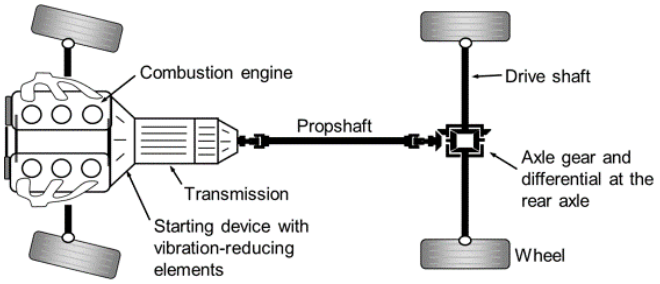


… Supported by Powerful CAE Software Tools

Applied simulation software: ARLA-SIMUL, ITI-SIM, SimulationX, ARMD, Laschet's Software Tools

Key Subjects and Applications in Automotive Engineering

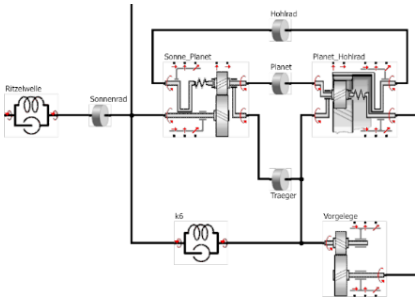
- **NVH Optimization**: studying NVH effects in the complete driveline like clonk effects due to backlash, tip-in/tip-out, gear rattling, shift rattling, idle rattling, creeping, start-up/run-up/slow-down, propshaft effects, driveline shunt
- **NVH Sensitivity Analysis**: based on customer requirements (supported by own NVH rating functions)
- multi-parameter **Analysis of Excitability** and comparing the results in correspondence diagrams
- studying interdependences of engine and transmission/driveline (**System Analysis**)
- steady-state simulation to optimize the **Absorber & Damper Design** (considering crankshaft, pulley, gears, etc.); special analysis of **Starter-Alternator-Damper-Systems**
- considering typical nonlinear effects as they occur in **clutches, DMF configurations, joint discs, dampers and friction elements** (e.g. stick & slip effects in friction discs; studying various **load scenarios**)



- **Heavy Load Studies**: like prompt start-up/run-up with extreme torque levels (torque changes)
- **Sensitivity Studies** depending on the backlash/elasticity/inertia distribution in the complete driveline including the comparison of alternative driveline configurations
- **Detailed Analysis of Gears/Transmissions:** automatic transmission (with converter), differential gear, planetary gear, dual-clutch transmission (DCT), various RWD / FWD / 4WD / AWD driveline configurations for passenger cars or trucks (commercial vehicles) depending on specific drive scenarios; **Feasibility Studies** of special gears
- studying **Auxiliary Drives and Power Take-offs (PTOs)** as part of the complete system engine in connection with engine maps as an excitation input
- **Simulation of the Road/Wheel-Contact** using slip characterictics
- special **Model Generation of Fired and Non-Fired Test Rigs** for engines (optionally compared with test signals)
- engine simulation with **Crankshaft-Starter-Generator (ISG)**
- model generation of **New & Advanced Drive Concepts** **(Hybrid Drives, E-Mobility, Special BEV Design)**

Further applications are also mentioned in my publication list, which I can provide on request.

Measurements and prototype testings are done via cooperative partners worldwide. In all these cases, we combine the design results and offer the customer a **complete design solution including CAE and test results** – carried out by a professional team of experts.



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