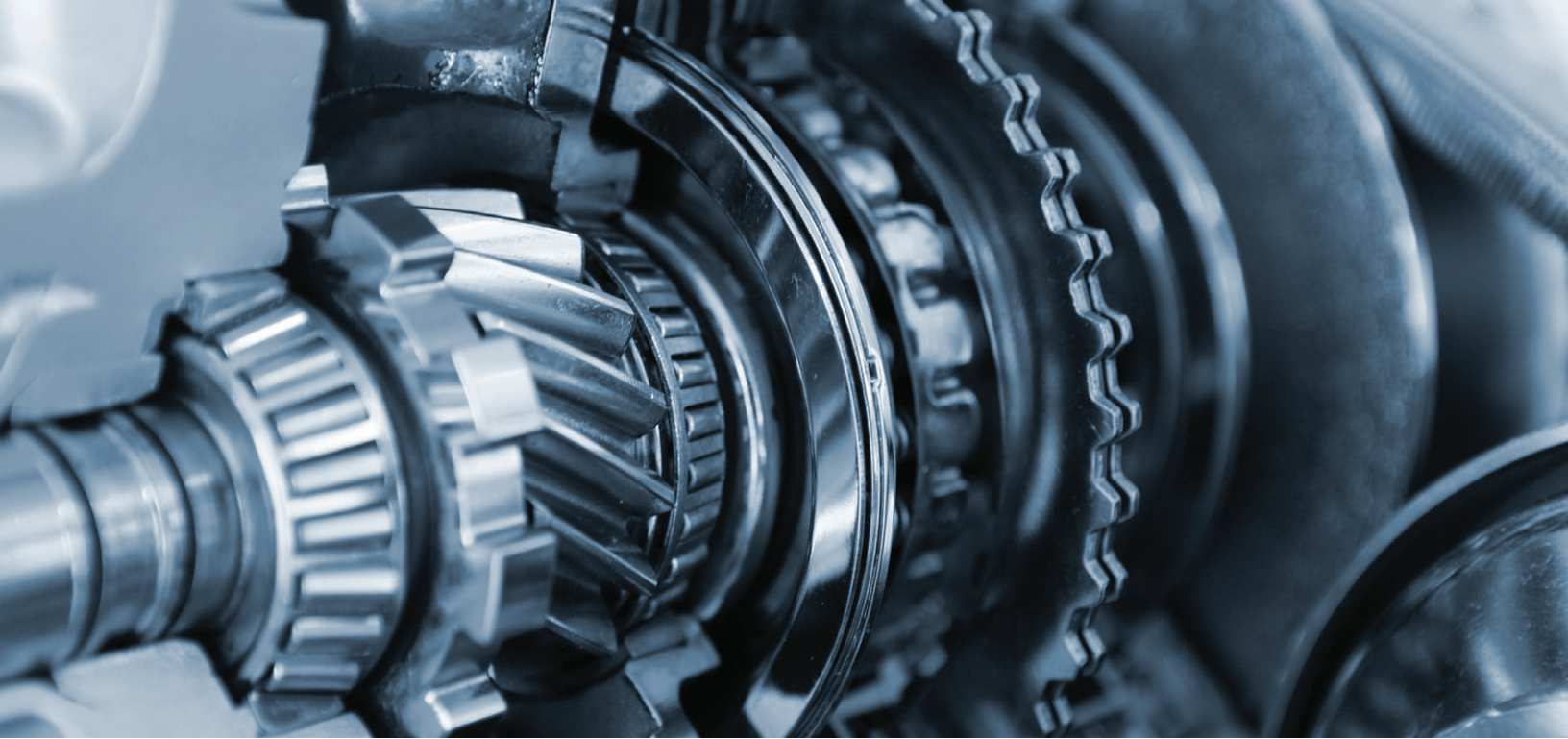




SIEMENS DIGITAL INDUSTRIES SOFTWARE

Gear-noise optimization

Reduce transmission rattle and whine with Simcenter Engineering services

Benefits

- Evaluate various transmission configurations
- Troubleshoot gear-noise issues using powerful test and simulation techniques
- Use a dedicated test bench for gear-pair transmission errors
- Learn about simulation to optimize gear contact and the transmission structure
- Validate simulation models with testing in all steps of the development process

Summary

Simcenter™ Engineering services enable customers to reduce gear-induced noise for low and high frequencies by combining Simcenter testing solutions for diagnostics with Simcenter™ 3D software and Simcenter™ Amesim™ software for simulation.

The growing pressure to reduce the weight and size of automotive transmissions combined with the increased demand for performance and efficiency improvements, such as friction reduction, affects the overall vehicle noise, vibration and harshness (NVH) behavior. This is especially the case for rattle and gear whine, which can negatively impact comfort. Rattle is a random noise caused by teeth impact in non-powered gears occurring with no load or at low torque. Whine is a stationary noise induced by torque fluctuation when there is contact between powered gears at every torque.

Solving gear-noise problems is complex as the noise generation mechanism depends on the entire driveline and all of its components. Yet suppliers often only consider the transmission unit during development, leading to unforeseen NVH problems when integrating it into the vehicle.

Conducting a proper analysis starts by diagnosing the issues, using a time- or frequency-domain analysis. Simcenter Engineering uses advanced testing and modeling methodologies to identify the root cause and define countermeasures. This approach can be applied in a scalable way, from investigating a single gear pair to analyzing the entire drive-line, according to the customer's need. A solution can be found by optimizing gear macro or micro configurations, or by changing the stiffness of the transfer mechanism.

A typical gear-noise optimization project is comprised of the following phases:

Test-based diagnosis

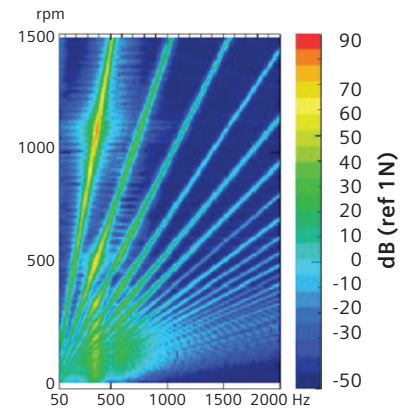
By using Simcenter™ SCADAS™ hardware for data acquisition combined with Simcenter™ Testlab™ software for data analysis, Simcenter Engineering experts are able to analyze the operational deflection shape (ODS), torsional vibrations and apply transfer path analysis (TPA). They can investigate issues in a time or frequency domain to help identify the issue, define a treatment strategy and determine boundary conditions for simulation.

Creating an accurate simulation model

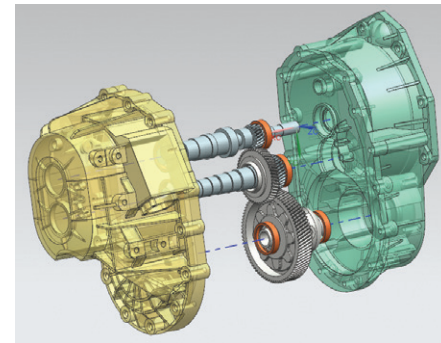
Simcenter Engineering experts use 3D simulation software and/or system simulation software to accurately model the noise phenomena in the frequency range of interest. By using correlation analysis and updates, Simcenter Engineering is able to compare simulation and test results, and improve modeling accuracy.

CAE optimization

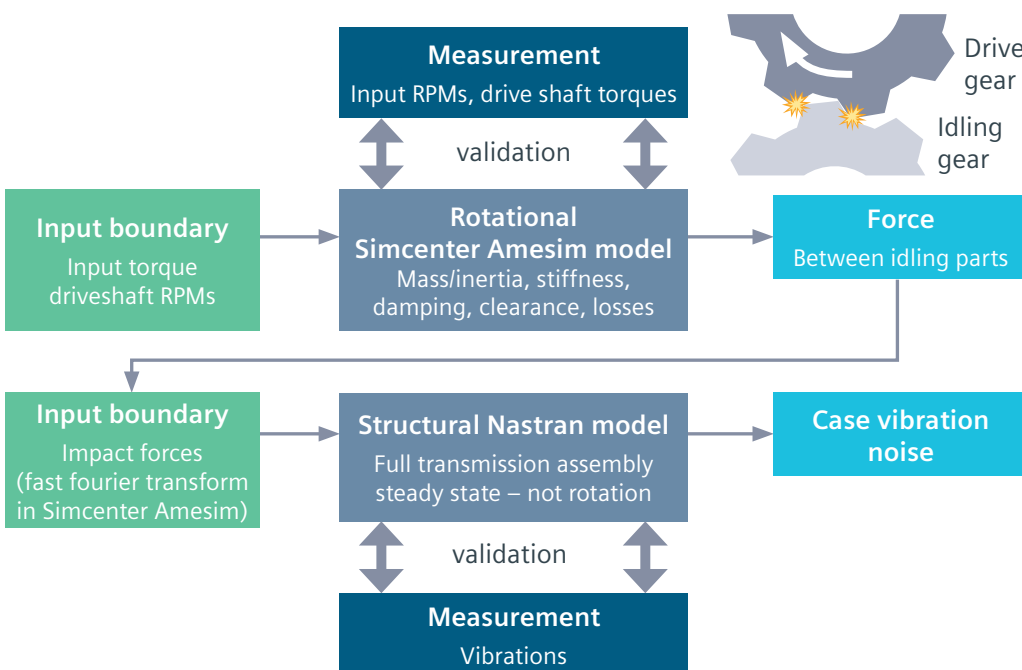
Simcenter Engineering experts employ correlated models for computer-aided engineering (CAE) based on weak-spot analysis and countermeasure definitions. They virtually evaluate potential solutions for gears, transmissions and drivelines. Simulations can involve the entire driveline system, from engine to wheels, or a local finite element analysis (FEA) of the gear pairing. If prototype parts are available, Simcenter Engineering experts perform a test validation using the proposed improvements.



Runup measurement with resonance problem.



Simcenter 3D gear modeling for gear-whine analysis.



Work flow for predicting rattle combining 1D and 3D simulations.

Siemens Digital Industries Software
[siemens.com/software](https://www.siemens.com/software)

Americas
 1 800 498 5351

Europe
 00 800 70002222

Asia-Pacific
 001 800 03061910

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