

Reconcilable differences

Test-based simulation bridges the gap between traditional test and CAE for noise and vibration

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Some noise and vibration test engineers have been reluctant to adopt simulation methods – based on a belief that test and CAE are diametrically opposed. Ironically, it is the inherent differences between test and simulation that makes them complementary. While simulation lacks the grounding of real-world data, testing provides just that. And although testing can be laborious and complicated, newer simulation methods can provide speed and simplicity.

Physical testing and numerical simulation are different representations of design reality, each with its own strengths and weaknesses. Gathering real-world data can be costly and time-consuming, and testing often results in large amounts of difficult to analyze and utilize data. With new energy-based simulation methods, data can be reduced to a few key parameters, simplifying analysis and guiding development efforts before prototypes are built or modifications implemented.

The ideal compromise is to combine the benefits of simulation and testing. By comparing the results of testing and simulation, the engineer gains a more effective understanding of the controlling physics, reduces the the risk of error and makes more informed design choices. The two methods can work together to help auto

manufacturers achieve faster, cheaper and more reliable product development.

The best of both worlds: Vibro-Acoustic Sciences, San Diego, California, offers two noise and vibration software products that leverage the synergy between test and simulation. AutoSEA2 and AutoSEA-X integrate analytical and experimental modelling techniques to give the engineer more control in solving to noise, vibration, and harshness (NVH) problems. At the core of the technology is statistical energy analysis (SEA), which applies the principle of conservation of energy to model the flow of vibration and sound energy within a system.

Requiring only standard test equipment (accelerometer, microphone, impact hammer, loudspeaker, etc), AutoSEA-X provides a structured environment for noise and vibration testing as well as data processing. The product automatically reduces large amounts of test data into a small set of SEA model parameters that directly affect NVH, giving test engineers a thorough understanding of the NVH characteristics of the system. In addition, AutoSEA2 allows the engineer to take full advantage of test results through simulation. AutoSEA2 can numerically predict different solutions to NVH problems, based on actual test data gathered by AutoSEA-X.

SEA hits the road: AutoSEA users have found consistency between the experimental and analytical SEA models. Major automakers in the USA, Europe and Japan have recently utilized combined experimental and analytical AutoSEA analysis to reduce NVH within their passenger vehicles and light trucks. Experimental and analytical models are typically built and validated in parallel, and the analytical model is then used to evaluate design improvements. For instance Honda R&D Company, Japan, found that their test measurements and analytical predictions were in close agreement. Their recently published JSAE paper entitled "Analysis of vehicle road noise using statistical energy analysis" shows that their AutoSEA model correctly predicted the on-road interior noise spectrum – and the effectiveness of a noise countermeasure – to good accuracy over the full frequency bandwidth.

Researchers can also use AutoSEA2 analytical models to plan experimental programs and better understand complex test results. AutoSEA-X allows free exchange of data from any NVH test process. Paul Geck, product engineering consultant, Ford advanced vehicle organization, states: "The Ford light truck group uses AutoSEA for correlating test results across a range of frequencies and