

SIEMENS

Ingenuity for life

Automotive and transportation

Volvo Trucks

Truck manufacturer uses Simcenter Testlab and Simcenter SCADAS to improve cabin sound quality

Product

Simcenter

Business challenges

Perform fast and efficient acoustic tests in all kinds of conditions

Reduce instrumentation and testing time and increase insights

Report easy-to-understand graphical results to designers and management

Keys to success

Use Simcenter Testlab 3D Acoustic Camera to streamline instrumentation and testing

Perform more multidisciplinary tests in a variety of circumstances

Provide in-depth analysis and graphical reports with easy-to-understand results

Tackle new acoustic challenges

Results

Improved truck cabin sound quality

Rapidly identified and analyzed the origin of annoying noise

Reduced instrumentation time to less than two hours

Reduced costly dedicated tests by obtaining more data from simultaneous test runs

Siemens Digital Industries Software solutions help Volvo Trucks quickly identify and analyze the origin of annoying noise

Make truck driving safe and enjoyable

"I love truck driving," says Theresia Manns. "The ride behavior of a heavyweight can't be compared to a car. You feel much more involved when driving a truck. There is no room for boredom as you have to constantly assess driving conditions and be in control."

Manns is not a professional truck driver, journeying millions of miles across Europe to bring resources and manufactured goods to their final destination. Instead, she helps develop next-generation trucks for the Volvo Trucks company in her hometown of Gothenburg, Sweden.

Her mission is to turn truck driving into an enjoyable, comfortable experience for drivers and passengers. As a noise, vibration and harshness (NVH) engineer, she understands the impact of ride comfort on attributes such as quality perception, driving pleasure and safety.

"My focus is to improve the sound quality in the truck's cabin," says Manns, a senior feature analyst in the noise and vibration laboratory, part of the Volvo Trucks Technology Group. "Sound quality is definitely not a negligible aspect of truck design and development. Poor sound



quality and the occurrence of disturbing noises cause additional stress and mental fatigue for the driver."

Scout for clues

Manns compares her job to that of a detective. Whenever a noise issue occurs, she investigates the origin of the problem and proposes appropriate countermeasures. "It is a very challenging role," she comments. "We have to be accurate in our analyses in order to find the exact cause of the annoyance, reveal the nature of the problem and propose an adequate solution to it."

The Simcenter Testlab™ 3D Acoustic Camera software, with its Simcenter™ Solid Sphere Array hardware, is one of Volvo Trucks' preferred tools for acoustic measurements.

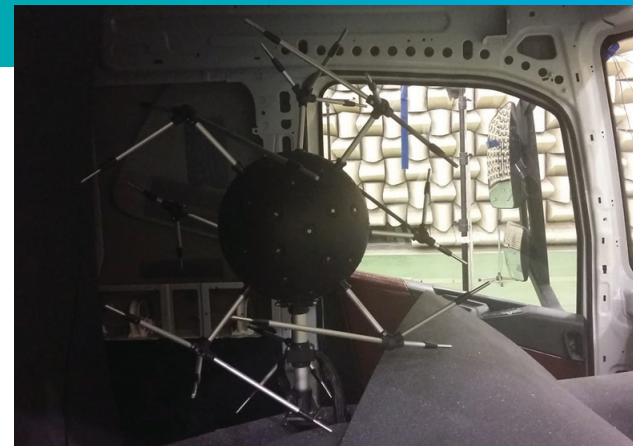
“We performed numerous tests with the Simcenter Testlab 3D Acoustic Camera before deciding to invest in it. Ultimately, the method convinced us, and today the array constitutes a valuable asset for our testing team.”

Theresia Manns
Senior Feature Analyst
Volvo Trucks

The spherical acoustic camera can be used to scan the inside of a truck's cabin, measuring the sound field while omitting reverbs, and overlaying the depiction of the real sound sources to the 3D geometry of the truck's interior. In other words, it displays acoustic hot spots on a photograph of the interior. In the past, Manns had to check many points to find the origin of a troubling noise, but now she can see it on the image. This method provides quick input for further investigations: The acousticians can estimate and rank potential noise issues based on the picture. As a result, the engineering team at Volvo Trucks can make relevant modifications and focus on the next action.

Time-saving testing methods

This drastically simplifies truck instrumentation and shortens instrumentation time. “It is difficult to estimate the time gain, but I know it to be consequential,” says Manns. “Before we would perform larger sound analysis on various occasions, doing one test at a time. Now we check many potential weak spots in a single measurement run. Setting up the Simcenter Testlab 3D Acoustic Camera takes us less than two hours, and the measurement is really quick. The array makes it a lot easier to assess multiple vehicles in shorter times, for benchmark, quality checks or hot spot detection on a prototype.”



Shown is the Simcenter Solid Sphere Array with extensions in a truck cabin.

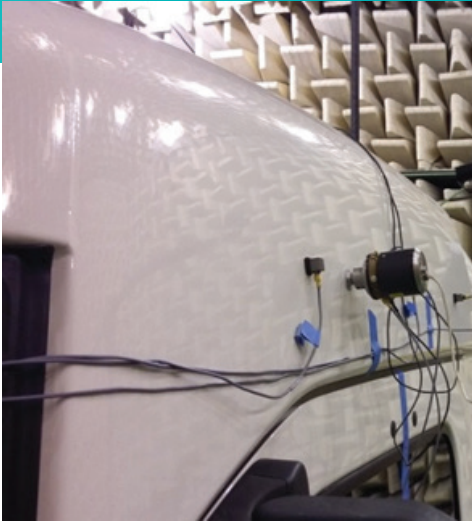
Time efficiency in measurement is a true asset when testing prototypes as those are rare, valuable items. The array is often employed when the team tests or benchmarks vehicles at its Swedish proving ground track Hällered. “When necessary, the tool allows us to perform multiple tests during the same measurement run as long as the other test is not influencing the acoustics,” says Manns. “We don't always need to dedicate the test to acoustic quality only.”

Although not easily quantified, the time gained by being able to perform multiple simultaneous tests is important.

The setup of the acoustic camera is relatively straightforward after a short induction, and it can be used in numerous circumstances. In the test cell, the acoustic camera is employed for the full system as

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Body-in-white measurement setup in an acoustic chamber.

well as component testing. The array is useful on the test track and in test cells, but it also serves the purpose of aero-acoustic measurements in the wind tunnel.

"The fact that we can use the array while performing other tests is a huge money saver," says Manns. "For example, we can instrument a truck in order to get our data while it is undergoing an aerodynamic test in the wind tunnel to see both aerodynamic and aeroacoustics impact simultaneously."

Knowing that wind tunnel tests are extremely costly, every gigabyte of collected data should be worth its money. While the installed camera records huge data sets on the connected Simcenter™ SCADAS Mobile hardware, the system's powerful Simcenter Testlab software facilitates value-added postprocessing, rapidly delivering results and information.

The convincing power of images

The acoustic camera system offers more than data capture. The obtained image overlay provides unmistakable evidence of the analysis results. Multiple data sets can easily be compared at a glance as the powerful analysis software features multi-batch processing capabilities. In that way,

different configurations are quickly compared and assessed, saving precious analysis time on individual data sets.

In the lower frequencies, acoustic pressure is often the cause of faintly perceived annoyances that prove to be tiresome for long-haul truck drivers. Using the Simcenter Testlab 3D Acoustic Camera, the NVH team at Volvo Trucks applies the equivalent source method (ESM) to obtain clear displays of the low- to mid-frequency noise sources. ESM also helps quantify noise sources so that they can be ranked in order of sound contribution.

Manns notes the system lets experts point to a selected sound source, displayed as a red spot on the computer screen and replay the audio file of the identified noise issue. Further, she explains it allows them to analyze, rank and compare the sound contribution of various large areas such as the vehicle's dashboard, side windows, roof air vents, etc.

Beyond the strong analysis capabilities of the system's software, Manns says, "The Simcenter solution is a user-friendly tool for presenting results to designers and the management team." To adapt a well-known phrase, since an image is worth a thousand words, the graphical results obtained with the array demonstrate the value of design modification.

Putting the test system through its paces

Manns is an enthusiastic user of the Simcenter Testlab 3D Acoustic Camera system, but admits that she and her team have not been blindly trusting the tool from the start: "We performed numerous tests with the Simcenter Testlab 3D Acoustic Camera before deciding to invest in it. Ultimately, the method convinced us, and today the array constitutes a valuable asset for our testing team."

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Solutions/Services

Simcenter Testlab
Simcenter SCADAS
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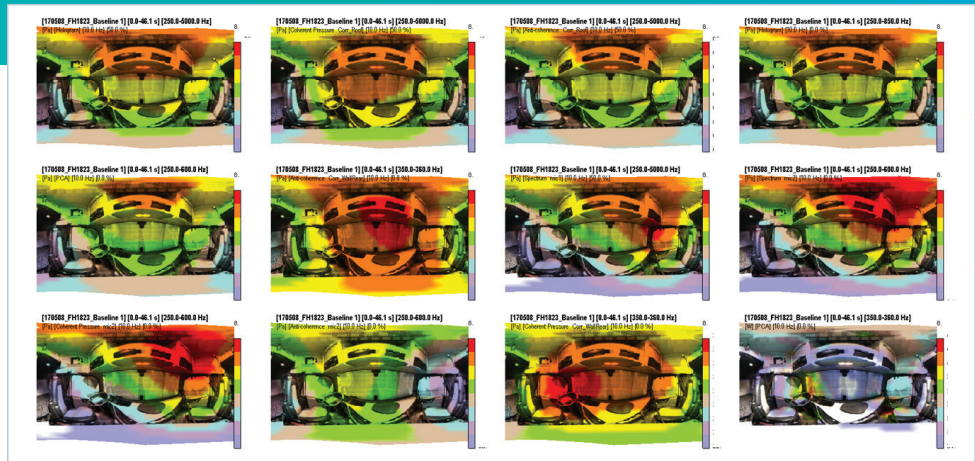
Customer's primary business

Volvo Trucks is the second-largest heavy-duty truck brand in the world. More than 95 percent of the trucks the firm builds weigh over 16 tons. Volvo makes vehicles that are sold and serviced in more than 140 countries.

www.volvotrucks.com

Customer location

Gothenburg
Sweden



Multiple data sets can easily be compared with multi-batch processing.

With the first electric trucks rolling out the Volvo Trucks production lines by 2019, it is expected that Manns and the other engineers in the team will take up an increased workload. As Claes Nilsson, president of Volvo Trucks, states in a press release: "This opens the door to new forms of cooperation with cities that target to improve air quality, reduce traffic noise, and cut congestion during peak hours since commercial operations can instead be carried out quietly and without tailpipe exhaust emissions early in the morning or late at night."

Achieving quiet operation has always been the challenge of the team of acousticians. In acoustic terms, truck electrification translates in different, often more tonal sound issues. There is no doubt the Simcenter Testlab 3D Acoustic Camera is a strong asset for helping to detect and eradicate those issues.

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