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Siemens PLM Software

Simcenter Sound Camera

Accelerating acoustic troubleshooting

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Understanding the source of noise

Sound is all around us, especially in the products we interact with every day. We call it noise when we dislike it. This can also be a sign of disruptive functioning. Therefore, engineering teams around the globe work hard to reduce noise in the products they develop.

The key is to quickly understand where sound comes from. Array-based sound source localization techniques give fast results that accurately identify sound sources, which can be measured in one shot and produce results that are easy to interpret.

The Simcenter Sound Camera™ system is a part of the extensive Simcenter sound source localization product portfolio, part of the Simcenter™ portfolio. It has a wide range of applications for many industries. This modular, high-quality digital microphone array offers an instant overview of sound sources for any noise-generating object. It can easily be used by occasional users as well as experts. It helps you confirm that you are working on the right problem, thereby accelerating acoustic troubleshooting.

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Providing sound source localization across industries

Automotive and transportation

Simcenter Sound Camera provides automotive engineering teams with versatility and flexibility for accurate sound source localization. It is used to investigate noise in diverse applications, such as acoustic leak detection, powertrain noise qualification, door slams, wind shield wipers and brake systems.

Heavy equipment and industrial machinery

When assessing noise issues for bulldozers or excavators in the lab or field, using Simcenter Sound Camera helps diminish overall noise by identifying the parts that require optimization. This helps to improve the brand perception of highly durable equipment.

Aviation and space

Complex and expensive in-flight or wind tunnel acoustic testing can be complemented with Simcenter Sound Camera to quickly and economically assess acoustic performance. It is an excellent tool for measuring exterior noise on the ground, and detecting cabin noise, seal leakage and source contribution.

Consumer and white goods

Brand perception is extremely important in the consumer and white goods sectors. As sound design can make or break a brand, large investments are made to perfect product acoustics. Using Simcenter Sound Camera can quickly reveal acoustic weak spots, letting engineers focus on solving the right problem.

A versatile and robust digital array

The Simcenter Sound Camera Digital Array is a modular, high-quality digital microphone array for sound source localization. It is an easy-to-set-up-and-use tool that helps both occasional users and engineers perform fast, accurate troubleshooting. The system has been designed to be a versatile solution, with arms that can be added or removed, making it an excellent tool to work with in multiple test conditions.

All electronics are integrated in the array. The device is directly connected to the software application with a single cable. It automatically measures the distance to the source object. Due to its lightweight, aluminum design, the array is robust and shockproof, yet it can be comfortably handheld throughout a measurement campaign. It can be easily and securely transported due to light but rugged packaging.

Whether indoors or in the field, on small handheld tools or gigantic manufacturing machinery, close to or far away from the sound source, the Simcenter Sound Camera Digital Array adjusts to your testing requirements in every situation. The system offers immediate and accurate sound source localization in a variety of testing situations.

	Center	Short arms	Long arms
Typical usage	Handheld, troubleshooting, typical distance <0.5m	All-round, near field and far field, typical distance <1m	Low frequency, big object, larger distance (>0.5m)
Frequency range (focalization) *	1,000-20kHz	400-20kHz	200-10kHz
Diameter and number of mics	30 cm with 45 mics	60 cm with 81 mics	150 cm with 117 mics
Minimal dynamic range (simulated)**	14dB @ 15kHz	16dB @ 15kHz	12dB @ 10kHz

* Real-time performance of beamforming with near-field focusing, improved postprocessing possible in Simcenter Testlab
** Experimental results typically 2dB lower

Adapting to a wide range of applications

The central part of the array integrates all electronics, microphones and the wide-angle camera. It's designed to cover a frequency range up to 20 kilohertz (kHz). It is typically used close to the source and in confined spaces. It targets mid-high frequency sources.

The dimension of the array can be increased by adding nine short arms with four microphones each, making it an all-round array. Suitable for spotting sound sources on objects with a width of +/- 2 meters (m), the array is typically positioned less than 1 m from the object to optimize localization results. To improve spatial resolution, it can be moved into the near field. The wide-angle camera allows you to keep the entire object visible, even at close range.

By mounting long-arm extensions containing eight microphones each, this up-scaled array becomes helpful in applications in which low-frequency phenomena are assessed, and when it is difficult to measure close to the source object.

The array maintains a high dynamic range of more than 10 decibels (dB) for acoustic beamforming. This allows you to detect sources of different levels in the same frequency band.

Interactive analysis

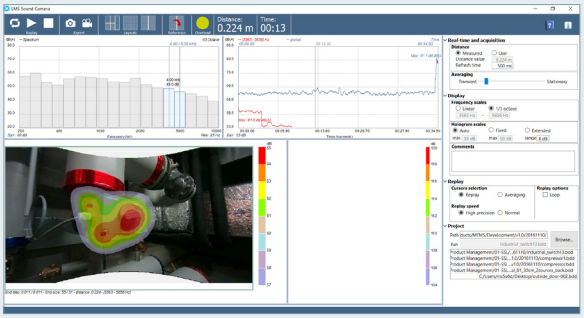
Simcenter Sound Camera shows results instantly after starting up. All relevant information is displayed in a single-sheet application in a clear and graphical manner. It does not require any training.

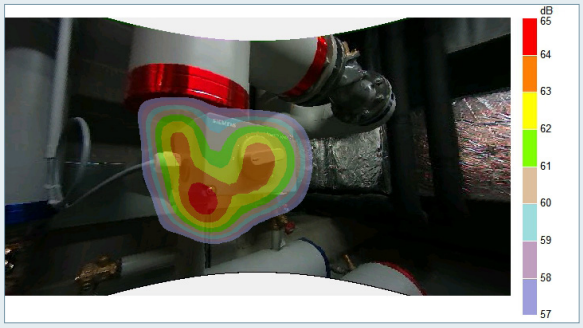
The real-time software is highly interactive, allowing you to change the frequency range, display settings and the averaging method. Any change updates the source location maps, allowing you to accelerate the investigation. Results can be stored in pictures or video, facilitating communication with the engineering teams. The averaging can be modified to better locate transient or stationary phenomena.

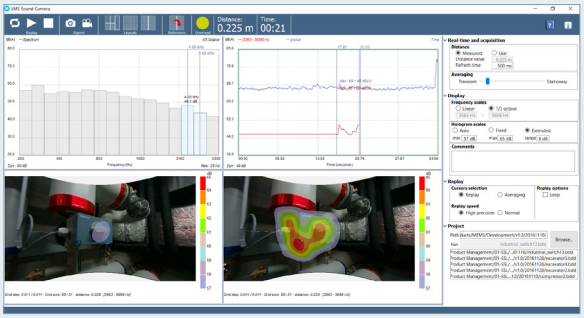
Data recording can be started at any time. It ensures that data is available for further analysis. Replaying recordings allows users to analyze events in other frequency bands and find impulsive events that were missed. Moreover, they can be analyzed with higher frame rates. Recordings enable users to look at the data once the measurement session is completed. They can be shared with engineering teams for deeper investigation into the measured data.

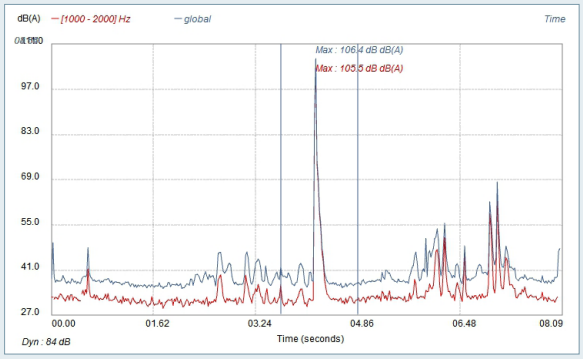
Any time during the measurement, real-time data can be compared side-by-side with a reference hologram, clearly emphasizing the impact of any design modification.

Available in real time









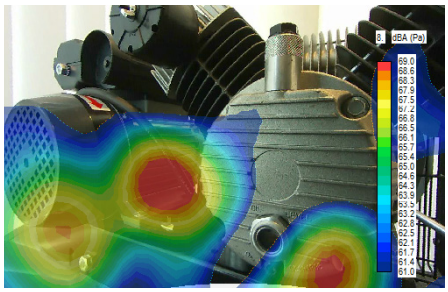
When Simcenter Sound Camera is started, it immediately shows the source locations in real time. Changes to frequency ranges of interest, averaging and display settings are applied immediately. This allows the user to locate sources quickly.

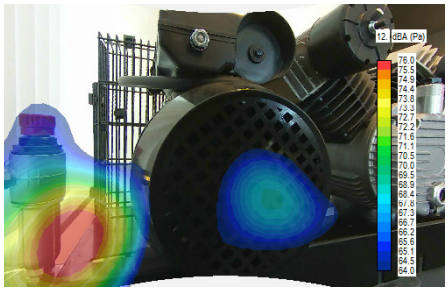
The results can be stored as a picture or video, and annotated with key data and user comments, facilitating easy reporting and communication of results. If required, raw data can also be shared for further analysis.

Reference display and extended display scales allow for a quick side-by-side comparison of results and absolute levels. This allows you to compare different product variants and/or operational conditions.

Replaying the recorded data, whether on-the-spot or later in the lab, allows the user to take a better look into measured data rather than just a video replay. All functionalities of Simcenter Sound Camera are available in real time and can be used to further analyze the data.

Boosting localization by moving into the near field





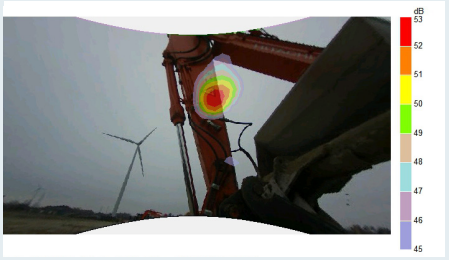
Using Simcenter Sound Camera enables you to accelerate acoustic troubleshooting by effectively locating sound sources from different distances and angles. With its short arms, the array can provide reliable results in the far field and near field.

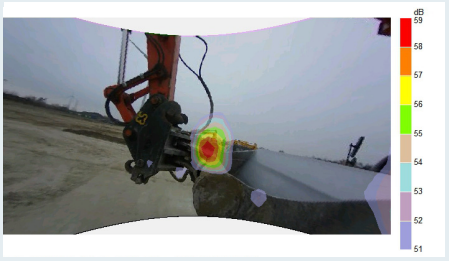
Initially, the object is tested from a distance in the far field. This gives a general overview of the source locations in different frequency bands.

Next, the array can be moved closer to the near field, as close as 5 to 10 centimeters (cm). This considerably improves spatial resolution, which is the ability to separate close sources. It allows users to separate sound sources that appeared in the far field as a single big red spot, but are in fact multiple distinct sources. The microphone array layout has been optimized for processing with near-field focalization; the infrared distance sensor automatically updates the calculation distance, and the wide-angle lens makes the entire test object visible.

Finally, the array can be moved to different angles around the source object to confirm the real source was not hidden by some other component.

Accurately locate moving sources





Noise sources that are moving, such as screen wipers, door slams and the moving arm of a crane, are more difficult to capture. The same goes for objects with changing operational conditions, such as starting up a powertrain, gear whine and brake squeal noise. Simcenter Sound Camera supports all such cases.

Transient conditions can be monitored in real time and recorded. A short exponential average can be applied in real time to get a balance between immediate updates, which gives a more refined source location. Transient phenomena can be selected interactively in the time-level display and analyzed in more detail. Additionally, replay allows you to boost precision by engaging a mode that calculates holograms at 25 frames per second (FPS).

Dealing with moving sources means the object is further away. The wide-angle lens captures the full cycle of the movement at the closest possible distance. The array with short-arm extensions has a view of +/- 2m wide at a distance equal to its array diameter of 60 cm. For bigger objects that require measuring from further away, it is advisable to apply the long arms.

Measure more data channels

The Simcenter Sound Camera Digital Array can also be directly connected to the Simcenter Testlab™ HD Acoustic Camera software application to acquire process data. This allows the user to benefit from the built-in four auxiliary data channels in Simcenter Sound Camera that support alternating current (AC) and ICP® input sensors. This can be accomplished without having to be connected to an Simcenter SCADAS™ hardware frontend.

When, on top, additional channels are required so you can combine the Simcenter Sound Camera Digital Array with Simcenter SCADAS Mobile, enabling synchronized multi-channel data acquisition. All attributes of an object are then measured simultaneously by various types of sensors, such as analog sensors for pressure, vibration, strain and temperature, digital inputs for controller area network (CAN) bus and acoustic heads, and advanced tacho sensors such as incremental encoders. The resulting measurement correlates the sound source to the other noise, vibration and harshness (NVH) attributes.

Simcenter Testlab provides increased engineering insight

Leveraging the Simcenter Testlab platform

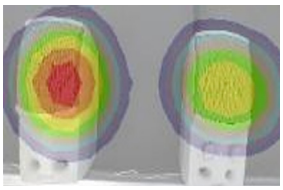
Simcenter Testlab combines different types of analysis on the same data to gain better understanding of the sound phenomena. More complex test scenarios such as engine runups are covered and can be automated, featuring start/stop functionalities based on rotational speed, allowing online and offline order tracking. Calculations of acoustic properties, such as level metrics and sound-quality metrics, can be correlated to source locations.

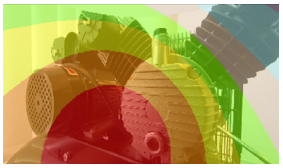
Improved spatial resolution

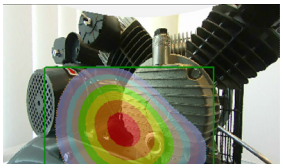
The Simcenter Testlab HD acoustic camera software offers additional processing capabilities to increase spatial resolution in lower frequencies. Methods are supported for near-field measurements using irregular Nearfield Acoustic Holography (iNAH), and far-field measurements deconvolution. Both are used not only to report source locations, but also to accurately estimate sound power contribution to rank sources.

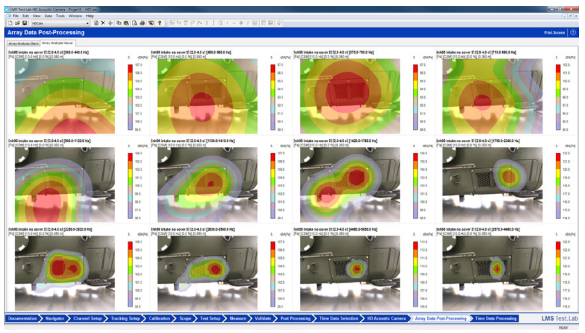
Improved productivity

For more systematic test approaches or other demanding needs, productivity can be drastically increased with the array batch processing capabilities and convenient hologram selection and comparison tool. Calculations are optimized on the graphical card, which considerably accelerates processing time. Up to 12 different results can be viewed side-by-side, whether it is localization results or pressure/power contribution spectra.









About Siemens PLM Software
Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of software solutions to drive the digital transformation of industry, creating new opportunities for manufacturers to realize innovation. With headquarters in Plano, Texas, and over 140,000 customers worldwide, Siemens PLM Software works with companies of all sizes to transform the way ideas come to life, the way products are realized, and the way products and assets in operation are used and understood. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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