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SM INSTRUMENT

# Now See your Sound and Vibration!

SeeSV-S205 is real-time sound cameras which implement FPGA-based high-speed beamforming technology. It developed for highly transient noise source detection, and also perform excellently on stationary noise sources. It is capable of capturing 25 images per second. Highly sensitive microphones detect small annoyance sounds immediately. Its major application is for Buzz, Squeak and Rattle (BSR) noise source detection as well as Noise, Vibration and Harshness (NVH) source visualization. The unique design of SeeSV-S205 makes accurately measuring sound easy. Now you can carry your sound camera anywhere to perform measurements. A Sound Camera has traditionally been heavy and expensive instruments. However, the SeeSV-S205 will open new doors and your ears. It has an ergonomic design, weighs only 1.97 kgs, and has a highly competitive price. Start your sound measurements with our new camera today.

## Features

### Hardware

- Innovative Unique Design
- High Sensitivity Digital MEMS Microphone
- High Resolution Optical Camera
- FPGA-based Real-Time Analysis
- Light Weight and Highly Portable, 1.97 kg
- No Control Box. Direct Connection with Ethernet Cable

### Software

- Real-time Sound Imaging
- High Speed Image Update, 25 FPS
- Impulsive Noise Detection
- Optimized for Highly Transient Noise
- Auto Image Ranging Function
- AVI & WAV Export and Replay
- Real-Time Frequency Adjustment
- Real-Time Distance Adjustment
- Linear/Exponential Image Averaging
- Effective Post Processing

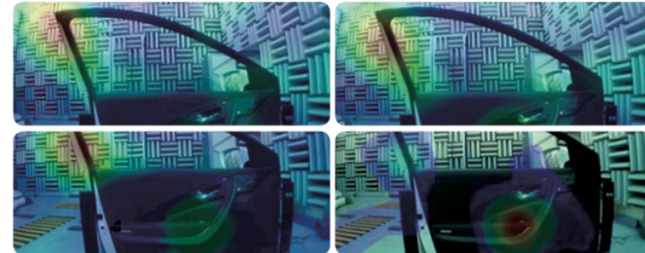


  
reddot design award  
winner 2013

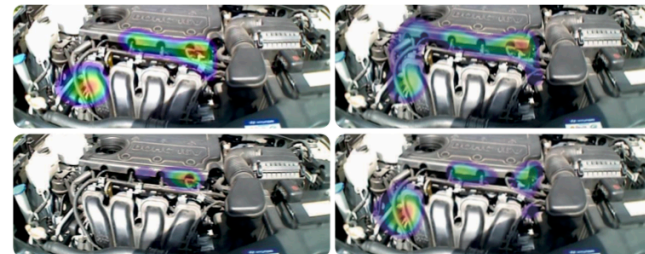
SeeSV-S205

# Portable, fast and accurate!

SeeSV-S205 is based on the latest FPGA technology, which makes it possible to integrate signal conditioning, data acquisition, filtering, and beamforming processing into a single chip. Our FPGA is fast; it generates 25 sound images per second with accurate resolution. Our single FPGA does not need high electrical power and is driven by Power of Ethernet (POE). Weighing a mere 1.97 kgs it is easily transportable and usable. MEMS microphone technology is improving every day and is achieving more than 56 dB signal-to-noise ratio. SeeSV-S205 uses highly accurate digital MEMS microphones for portable, fast, and accurate measurements.



The detection of squeak and rattle noise of vehicle door and its window.



The detection of high frequency noises from a vehicle engine.

## What is FPGA?

A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing-hence "field-programmable." The FPGA configuration is generally specified using a hardware description language (HDL), similar to that used for an application-specific integrated circuit (ASIC). [www.wikipedia.org](http://www.wikipedia.org)



# What is it?

SeeSV-S205 is the handheld sound camera. A sound camera visualizes sound in color contours, similar to the way a thermal camera visualizes temperature. When developing/repairing home appliances, vehicles or vessels, engineers can quickly spot the source of noise such as buzz, squeak and rattle, which is difficult to detect otherwise.

Five spiral arrays of high-sensitivity digital microphones and a high-resolution optical camera superpose sound images onto visual images in real-time (at 25 frames per second), enabling intuitive visualization and recording (in AVI and WAV format) of the sound data.

This innovatively small and light-weighted sound camera weighs only 1.97 kg and measures 39cm wide and 38cm high, with its ergonomically designed grips providing exceptional usability.



A sound camera visualizes sound in color contours, similar to the way a thermal camera visualizes temperature. When developing/repairing home appliances, vehicles or vessels, engineers can quickly spot the source of noise such as buzz, squeak and rattle, which is difficult to detect otherwise.



Unlike any other existing products, SeeSV-S205 allows users to freely move and interactively explore various noise sources even in upper surfaces, lower surfaces, or narrow spaces. See the exemplary videos and applications of SeeSV-S205 at <http://www.youtube.com/sminstruments>.

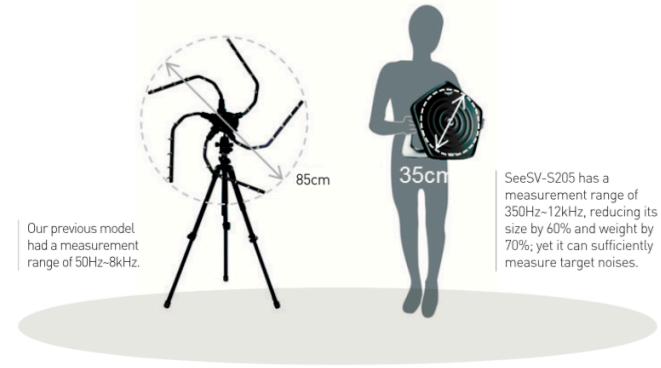
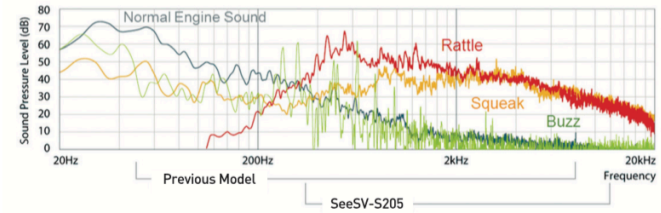
See the exemplary videos and applications of SeeSV-S205 at <http://www.youtube.com/sminstruments>.

# What is the challenge?

Noise from industrial products may imply design faults, abrasion of components, or other problems. However, it is not easy to spot the noise source with bare eyes and ears. A sound camera can be useful in this situation. But existing models were large and heavy, thus could only be used on a tripod. Installation was complicated, and exploration of upper/lower surfaces or narrow spaces was difficult. We developed a new sound camera that a user can freely move and interactively explore the target with. The design requirements were:

- | Size and weight should be appropriate for mobile use, without compromising the performance level.
- | Usability should be ensured, considering both usage scenarios and ergonomics.
- | A user should be able to use the device without prior knowledge about acoustics.
- | Microphones should be safely protected during mobile uses and storage.
- | Design should be aesthetically pleasing and intuitively exhibit its identity and usage.

In order to measure low frequency noises [50Hz-] with long wavelengths, our previous model had large spaces between microphones. Based on the idea that noises from industrial products such as BRS have relatively higher frequencies, we moved the measurement range [350Hz-], drastically reducing the size enough for mobile use.



## What makes this an excellent design solution?

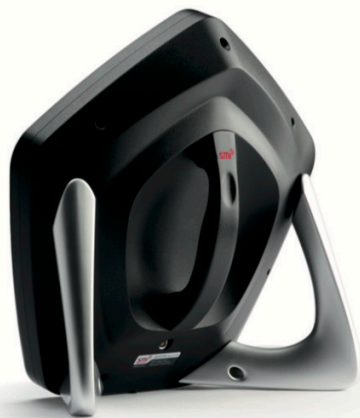
The ergonomically designed handles provide excellent usability. Its central handle at the back enables stable one-hand grip, allowing the user to control the noise source or computer with the other hand. Two side handles enable the user to comfortably hold the camera in many different ways, also providing steady stand at the same time. Its symmetric form does not discriminate handedness; the two-hand grip enables women and older users to handle the device with less physical strength.

Simplified preparation process makes SeeSV-S205 easy to use. The previous model required users to assemble microphone modules and connect it to a controller and computer with multiple cables. SeeSV-S205 mounted all the sensors inside the main body and unified the cables, also making storage/transportation easier. Its intuitive software interface lets anyone measure noises only with simple instructions.

Designed as a single solid body without moving parts, SeeSV-S205 is durable. Also, microphones are located in between embossing wave patterns, protecting them from scratches/damages.

SeeSV-S205's overall appearance informs even first-time users to grab the handles, aim to the front, and stand the device on the side handles. The embossed pattern of concentric circles at the front visualizes sound wave propagation, signifying its identity as a sound measuring instrument. Pentagonal form of the main body harmonizes with the five spiral microphone arrays, with the side handles completing the unique design of SeeSV-S205.

Even the first-time users intuitively understand how to hold, use and stand the device. Pentagonal form of the main body harmonizes with the five spiral microphone arrays, with the side handles completing the unique design of SeeSV-S205.



Its central handle at the back enables stable one-hand grip, allowing the user to control the noise source or computer with the other hand.



Two side handles enable the user to comfortably hold the camera in many different ways.



Two side handles also provide steady stand.

The three handles at the back provide excellent usability, considering both usage scenario and ergonomics.

## It's a camera! Easy operation!

SeeSV-S205 include simple, easy, and high performance software. It automatically starts their operation as soon as the user runs the software. You can record sound videos with our intuitive graphical user interface. 'Record' and 'Stop' buttons control video recordings and our 'Replay' button replays the recorded video at various speeds of your choosing. It is almost as simple as using an mp3 player. There are three knobs on right side: 'Threshold,' 'Image Range,' and 'Image Average.' These make controlling the quality of your image simple.

The screenshot shows the SeeSV software interface with various controls and data. Labels point to specific features:

- Software Mode [Record/Review]
- Converting to Video Clip
- Image Display
- Play
- Recorder
- Capture Image to Picture
- Image threshold
- Image Range
- Image Average
- Stop
- Folder
- Documents
- Play Speed
- Play Speed (1/n)
- THRESHOLD (LED)
- IMAGE RANGE (LED)
- IMAGE AVERAGE (LED)
- Band Pass Filter
- Low Cutoff
- High Cutoff
- Time Signal
- Setting Preset
- Open
- Save
- Camera
- DAQ
- Signal Graphs
- Graph Selector
- Device Status
- Band Pass Filter

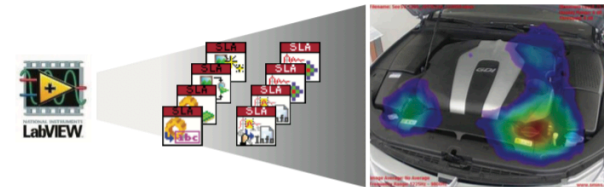
# Features & Specifications

SeeSV-S205 is a real-time handheld sound camera which implements FPGA-based high speed beamforming technology. SeeSV-S205 is developed for Buzz, Squeak and Rattle (BSR) noise source detection as well as Noise, Vibration and Harshness (NVH) source visualization. It displays transient noise effectively due to its high image per second update rate. The unique design of SeeSV-S205 makes measuring sound easy.



# SeeSV LabVIEW Application Program Interface

SeeSV LabVIEW API is acquired and analyzed data through using LabVIEW tool which is developed by National Instruments. SeeSV LabVIEW is classified with SeeSV Post Processing and SeeSV Real-Time according to functions. SeeSV Post Processing is checked images and data information to importing from saving files on SeeSV-S205. SeeSV Real-Time is got and analyzed real-time images and data information immediately. Using SeeSV LabVIEW, users can be developed functions and graphical user interface on their own by using SLA programming.



## Features

### Hardware

- Unique, Innovative Design
- High Sensitivity Digital MEMS Microphone
- High Resolution Optical Camera
- FPGA-based Real-Time Analysis
- Light Weight at 1.97 kg

### Software

- Real-time Sound Imaging
- High Speed Image Update, 25 FPS
- Impulsive Noise Detection
- Optimized for BSR detection
- Auto Image Ranging Function
- AVI & WAV Export and Replay
- Real-Time Frequency Adjustment
- Linear/Exponential Image Averaging
- Effective Post Processing
- FFT and Octave Analysis

## Applications

- BSR Noise Detection
- NVH Noise, Power Train Noise Detection
- Noise Leakage Detection

## Specifications

| Microphone Array |   |
|------------------|---|
| Mic. Type        | Digital MEMS Microphone                                 |
| Number of Mic.   | 30  |
| Mic. Sensitivity | -26 dBFS, at 94 dB SPL                                  |
| Array Diameter   | 40.6 cm   |
| Frequency Range  | Min. 350 Hz   |
|                  | Max. 12 kHz   |
| Meas. Distance   | Recommended<br>2 kHz ~ 10 kHz<br>(60 deg 1/2 Bandwidth) |
|                  | 0.2 m ~ 5 m<br>(Recommended)                            |
| Weight           | 1.97 kg   |

| Data Acquisition and Processing |                  |
|---------------------------------|------------------|
| Sampling Rate                   | 25.6 kS/s        |
| Imaging Algorithm               | Beamforming      |
| Image Ranging                   | Automatic/Manual |

| Environmental Condition |                |
|-------------------------|----------------|
| Operating Temp.         | -20 °C ~ 50 °C |
| Humidity                | 10~ 85 %       |

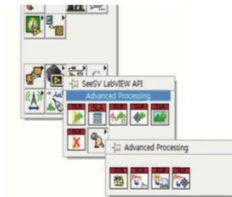
## Function

### SeeSV Post Processing

- Open Data File
- Get Data Properties
- Load Time Data
- Load Beamforming Power
- Load Image
- Close File
- Initialize Spectral Beamforming SeeSV-S205
- Generate Spectral Info
- Generate Filter Info
- Perform Spectral Beamforming

### SeeSV Real-Time

- Open Communication
- Read Communication
- Convert Configuration
- Write Configuration Load Image
- Close Communication
- UDP Read SeeSV Info
- Create File
- Write File
- Close File
- Average Beamforming
- Image Range Beamforming
- Combine Image



# WiFi & Battery Option

SeeSV-S205 Option is also a real-time handheld sound camera which implements FPGA-based high speed beamforming technology. SeeSV-S205 Option is developed for Buzz, Squeak, and Rattle (BSR) noise source detection as well as Noise, Vibration, and Harshness (NVH) source visualization. It displays transient noise effectively due to its high image per second update rate. SeeSV-S205 Option is built-in the Wi-Fi module and Battery pack.



## Features

### Wi-Fi Module

- IEEE802.11a/b/g/n Wi-Fi
- 2.4/5GHz
- Speed: Max 300Mbps
- Reconnect less than 0.05sec.
- PCB Antenna

### Battery Pack

- 4 cell 14.8V Li-Polymer 10800mAh battery pack
- Internal 14.8V PCB for battery protection;
- Write Configuration Load Image
- Maximum charging rate: 2.7Amps
- Dimensions: 7.6cm x 6.1cm x 0.2cm
- Weight: 0.3 kg
- Temperature: 0 ~ 40 °C

## Applications

- BSR Noise Detection
- NVH Noise, Power Train Noise Detection
- Noise Leakage Detection

## Specifications

| Microphone Array |   |
|------------------|---|
| Mic. Type        | Digital MEMS Microphone                                 |
| Number of Mic.   | 30  |
| Mic. Sensitivity | -26 dBFS, at 94 dB SPL                                  |
| Array Diameter   | 40.6 cm   |
| Frequency Range  | Min. 350 Hz   |
|                  | Max. 12 kHz   |
| Meas. Distance   | Recommended<br>2 kHz ~ 10 kHz<br>(60 deg 1/2 Bandwidth) |
|                  | 0.2 m ~ 5 m<br>(Recommended)                            |
| Weight           | 2.3 kg  |

| Data Acquisition and Processing |                  |
|---------------------------------|------------------|
| Sampling Rate                   | 25.6 kS/s        |
| Imaging Algorithm               | Beamforming      |
| Image Ranging                   | Automatic/Manual |

| Environmental Condition |                |
|-------------------------|----------------|
| Operating Temp.         | -20 °C ~ 50 °C |
| Humidity                | 10~ 85 %       |

※ Sale and purchase of SeeSV-S205 Option model can be limited in some countries.

# Accessories

SeeSV-S205 accessories can help to detect BSR sources conveniently under various environment conditions. See below for references.



### Car Power Cable Connector

- Connector : LEMO to Cigar jack
- Cable Length : 1.8M
- Power : DC12V 5A



### Adapter For Standard Calibration

- Standard : IEC 942 (1998) Class 1
- Calibration Pressure : 94 and 114 dB SPL
- Calibration Frequency : 1000 Hz
- Adaptor : Special Cap



### Carrier

- Internal Dimensions  
: 32.5 x 16 x 44.5 cm (12.80 x 6.30 x 17.52 in)
- External Dimensions  
: 35.5 x 32 x 51.5 cm (13.98 x 12.60 x 20.28 in)
- Notebook Compartment  
: 28.5 x 4 x 38.8 cm (11.22 x 1.57 x 15.28 in)
- Weight : 4.7 kg (10.34 lbs)



### Tripod

- Maximum Height with Extended Center Column : 179 cm
- Maximum Height : 150 cm
- Minimum Height : Closed Length : 49.7 cm
- Weight : 2 kg
- Maximum Load Capacity : 5 kg
- Plate Supplied With The Head : 200PL-14

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