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PLACID ACOUSTIC CAMERA
PACAM 64

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New Calibrated Instruments for Registering Noise and Vibration

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PLACID ACOUSTIC CAMERA

PACAM64

Frequency, Aperture Size and Image Resolution

An acoustic camera produces an image where the intensity of each pixel represents the amplitude of acoustic waves coming from the corresponding direction. This is akin to an optical camera producing an image where each pixel represents the intensity of light coming from the corresponding direction.

For an optical camera, the lens focuses light coming from a certain direction to the corresponding pixel on the sensor. Each pixel in the image represents the intensity of light coming from a specific azimuth (angle in the horizontal plane) and elevation (angle in the vertical plane). The lens does this by slowing and delaying the light waves hitting the lens by precisely the right amount, so that all waves coming from a certain direction arrive in phase in the focal plane at the position of the corresponding pixel.

An acoustic camera does much the same thing, except that the work of the lens is replaced by a digital computational engine that processes signals captured by an array of microphones

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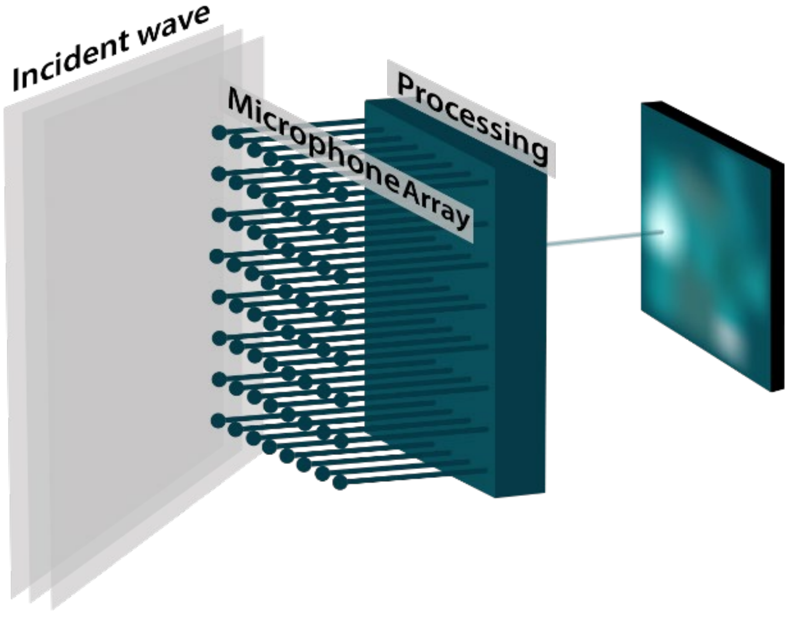

An array of microphones captures the sound waves hitting the array from many different directions. For every pixel, a massively parallel digital processing engine applies specific delays, and sums the signals from every microphone, so that the signals from a specific angle of incidence (azimuth and elevation) arrive in phase. Figure 1 shows that process for a specific pixel. Note that for every arrow from the microphone array, a different delay must be applied, corresponding to the specific angle of incidence and the corresponding pixel. In the simplest implementation, the intensity of the pixel is calculated as the energy of that sum signal, averaged over an adjustable time.

Features

Because the processing is implemented digitally, a few features are possible, some of which are not possible for an optical camera:

- The sum signal corresponding to a any pixel position is available and can be streamed out of the processing engine to be listened to. This process is called “beamforming”. The microphone array can be digitally steered to the angle of incidence corresponding to any pixel in the field of view and focus on that source. In addition, since the image shows the azimuth and elevation of the loudest source in the field of view of the camera, the beamformer can follow that “hot-spot” as it moves across the field of view.
- A filter can be applied to the processing, such that the camera is only sensitive to certain frequencies. Furthermore, that filter can be adjusted in real-time, while the images are being captured.
- The integration time used to calculate the energy of the sum signal for each pixel can be adjusted. This is called the “persistence” of the image and is very similar to the concept of shutter speed for an optical camera. With longer persistence, the resulting image is clearer and less noisy, but successive images blur into each other, making it more difficult to track highly dynamic scenes.

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Specification

- PACAM 64 is an 8×8 microphone array, and real-time beamformer. It can build a 32×32 pixel image of sound sources in real-time, with adjustable frequency response within 20 Hz to 8 kHz.
- Its massively parallel beamforming DSP allows the instrument to build each pixel concurrently with no missed sample.
- The instrument can be controlled, and the images can be retrieved using an open protocol based on virtual Com port. That open protocol can be used on any platform that has a generic USB CDC driver. That includes Windows, Linux and Mac-OS.
- The instrument can stream audio to the host platform through a USB-Audio interface. Through that interface the instrument is seen by the host as a USB microphone. That audio signal is the output of the beamformer and can be steered digitally to any azimuth and elevation in the field of view of the camera. Using the provided Windows application, the beamformer can even track any acoustic source in the field of view.
- That USB-Audio interface works on any platform that has a generic USB-Audio driver. That includes Windows, Linux and Mac-OS.
- A complete Windows application is provided to operate the camera, view and record images of the sound source.

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Optional

THE OPTICAL KIT FOR PACAM64

The Optical Kit for PACAM64 includes the following:

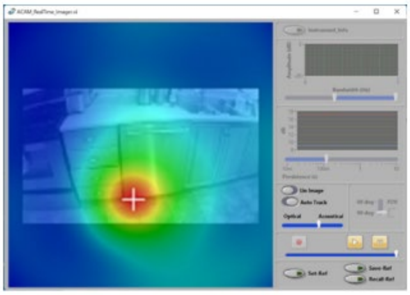
- A USB camera
- A bracket to mount the camera on the back of the ACAM_64 casing
- Full support in Instrument Manager V12.0 and up

VALUE OF AN OPTICAL IMAGE

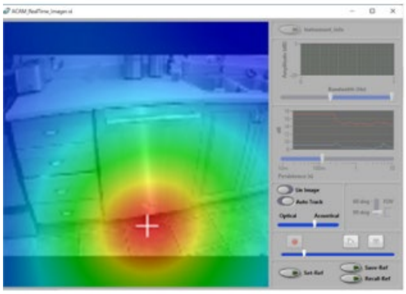
PACAM64 presents acoustic images, showing sound sources in the field of view of the instrument. But it does not show an optical image, so it is difficult to match acoustic hot zones with the actual pieces of equipment creating the noise. The optical camera kit captures the scene in parallel to PACAM64, and Instrument Manager presents the optical image superimposed onto the acoustic image.

FIELD OF VIEW (FOV)

The field of view of the optical camera is 80 deg x 43 deg. As the field of view of PACAM64 is adjusted, the relative size of the optical image will change accordingly:



When PACAM64 is set at 90 deg FOV, the optical image occupies only the central portion of the acoustic image



When PACAM64 is set at 60 deg FOV, the optical image occupies almost all the area of the acoustic image

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Specification of OPTICAL KIT

Brightness	Auto
Contrast	Auto
Lens	High-quality glass lens
Connectivity	USB
Field of View	80 deg x 43 deg
Color Depth	Grayscale (Instrument Manager)
Displayed Resolution	Width: 128 pixels (Instrument Manager)
Rate of Image Capture	Up to 27 images/s
Mounting	Clips to adaptor bracket for PACAM64