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DYNAMIC NOISE VISUALISATION AND POSSIBILITIES OF MEASUREMENT BY THE ACOUSTIC CAMERA

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Abstract:

The Acoustic Camera was the first commercially viable system using beam forming to visually localize acoustic emissions. The tool is now used in a variety of industries and has a growing customer base worldwide. The advantage of the Acoustic Camera: it is a light-weight, modular and therefore flexible system which is rapidly set up and ready to use. After a few minutes only, you get the first acoustic images on your computer screen. The software allows a clear, exact and fast analysis of noise sources. The benefits of the Acoustic Camera are straightforward: Noise sources are visualized, quality problems are detected and development times are reduced.

Keywords:

Acoustic camera, measurement, noise, visualisation.

1 INTRODUCTION

This article describes some field experience on the use and measurement results and procedures of the Acoustic Camera. By the use of Acoustic Camera in measurements it is possible to differentiate and localize different sources. Acoustic emission monitoring is getting increasingly important with engineering product design. An acoustic camera was recently developed as a new measuring device and constitutes a strong innovation made for localizing noise emissions.

2 TEORETICAL PRINCIPLES OF ACOUSTIC CAMERA

A digital camera is taking an image of the noise emitting object. At the same time an exactly computed array of microphones acquires and records the sound waves emitted by the object. A special developed software calculates a sound map and combines the acoustical and the optical images of the sound source. The Acoustic Camera can extend the time and frequency selectivity and add a location-selective component. With this method the sound signal is shown and also a sequence of acoustic images can be acquired – acoustic films are generated. Nevertheless the Acoustic Camera comprises traditional analysis methods as well, like A-weighting, one-third octave band and narrow band analysis.

With the Acoustic Camera it can be precisely analysed when, where and which part is occurring the sound emission. The so far used analyses do have an important disadvantage as the location of the emission is limited or not possible. If the sound from several spots of an appliance is to be acquired simultaneously, individual microphones are required for each reading point, and they must be placed very close to the object – a time consuming and costly method.

The whole measurement and subsequent analyses are characterized by:

- high accuracy,
- high speed,
- dynamic operational mode,
- high effectiveness,
- transparent result processing (coloured acoustic maps, movies, records).

The Acoustic Camera is based on beamforming of a conventional delay-and-sum beamforming in the time domain.

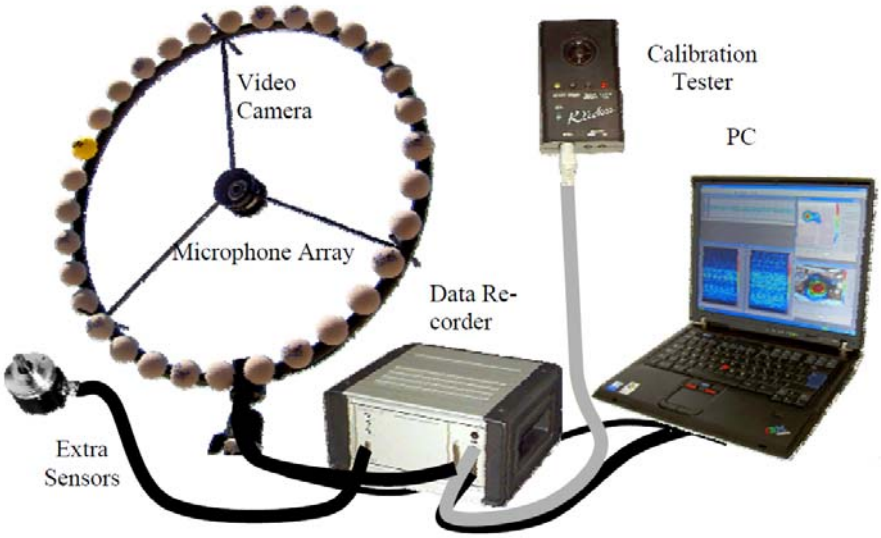

Figure 1: Measurement tool of acoustic camera

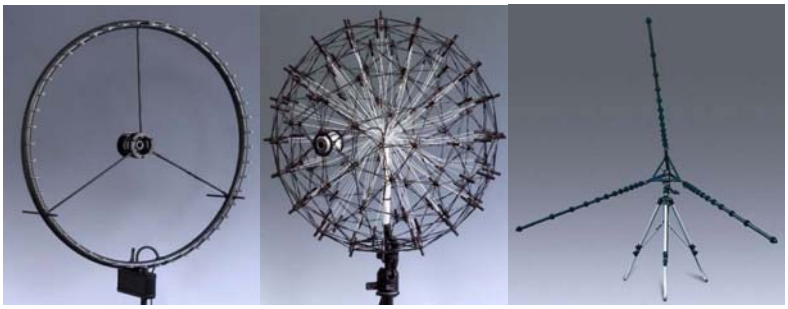

Figure 2: Microphone arrays

3 APPLICATION OF ACOUSTIC CAMERA

The fields of application are as various as the world of sound and range from measurements in the open field, acoustic labs to the use in automation engineering.

The benefits of the Acoustic Camera are straightforward: Noise sources are visualized, quality problems are detected and development times are reduced.

Application of acoustic camera:

- localization and identification of noise sources,
- quantitative and qualitative analyze of noise sources,
- diagnostic and control measurements of machine and equipment,
- noise records,
- acoustic video and picture records,
- noise reduction.

The acoustic camera comprises traditional analysis methods as well, like A-weighting, one-third octave band analysis and narrow band analysis, filters, and many more. Based on these methods far more detailed research becomes possible. In a spectrogram, for example, sounds can be highlighted in the time and frequency ranges. The acoustic camera then shows the exact origin of this sound. The approach can also be made from the other end: After selection of a spot on the measured object, the sound originating from that spot can be reconstructed, visualized and broken down into its spectral components. It is also possible to replay the sound via speakers - any time after the measurement is completed.

Acoustic pictures and videos acquired by the acoustic camera is possible also use for quality control and diagnostic different machines and equipment which are producing noise during their activity.

The one of measurement results is spectrogram. Spectrogram is used to generate acoustic photos by studying tonal components and to easily realise filtering including playback of selected area, so that the display/generation of the acoustic photo is optimized.

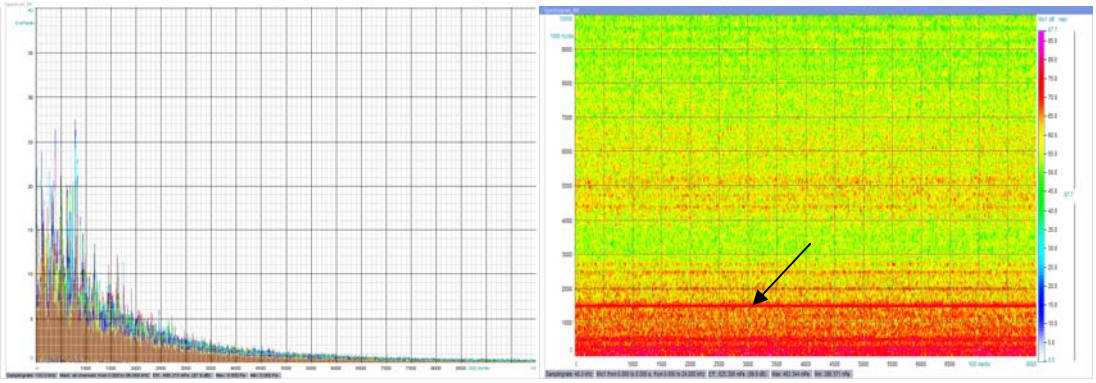

Figure 3: Spectrum and spectrogram

Next acoustic pictures and diagrams presents results of measurement air cooling equipment. First acoustic picture present overall noise emissions of whole equipment.

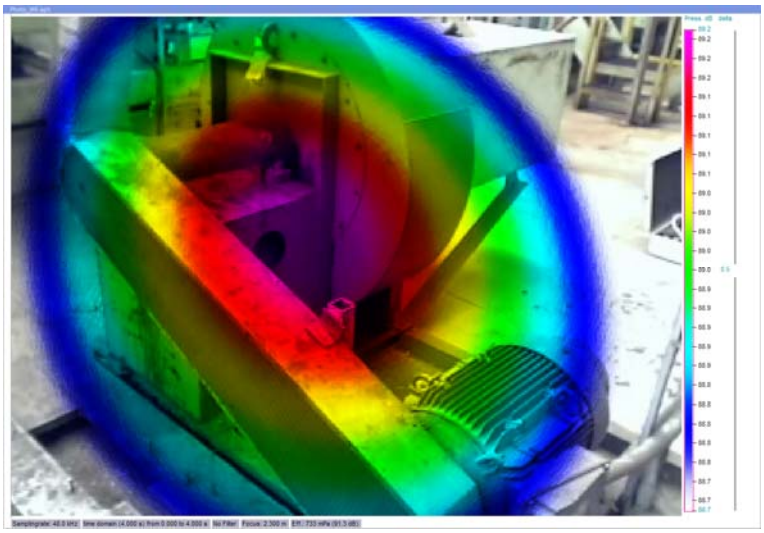

Figure 4: Overall noise emissions

Next picture presents noise spectrogram for this equipment. From this spectrogram was created two different acoustic pictures for two different frequency band. First acoustic picture was created for frequency band 200 – 300 Hz. This frequency band is the most critical and the share of overall noise emissions. Also was created second acoustic for frequency about 3000 Hz where is significant cyclic repeat noise. Creation of acoustic picture clearly show noise source at the field 3000 Hz. This noise was not hearable due the reason of lower noise intensity and was covered by the noise of other parts. Next maintenance discovers wrong seating of driving shaft.

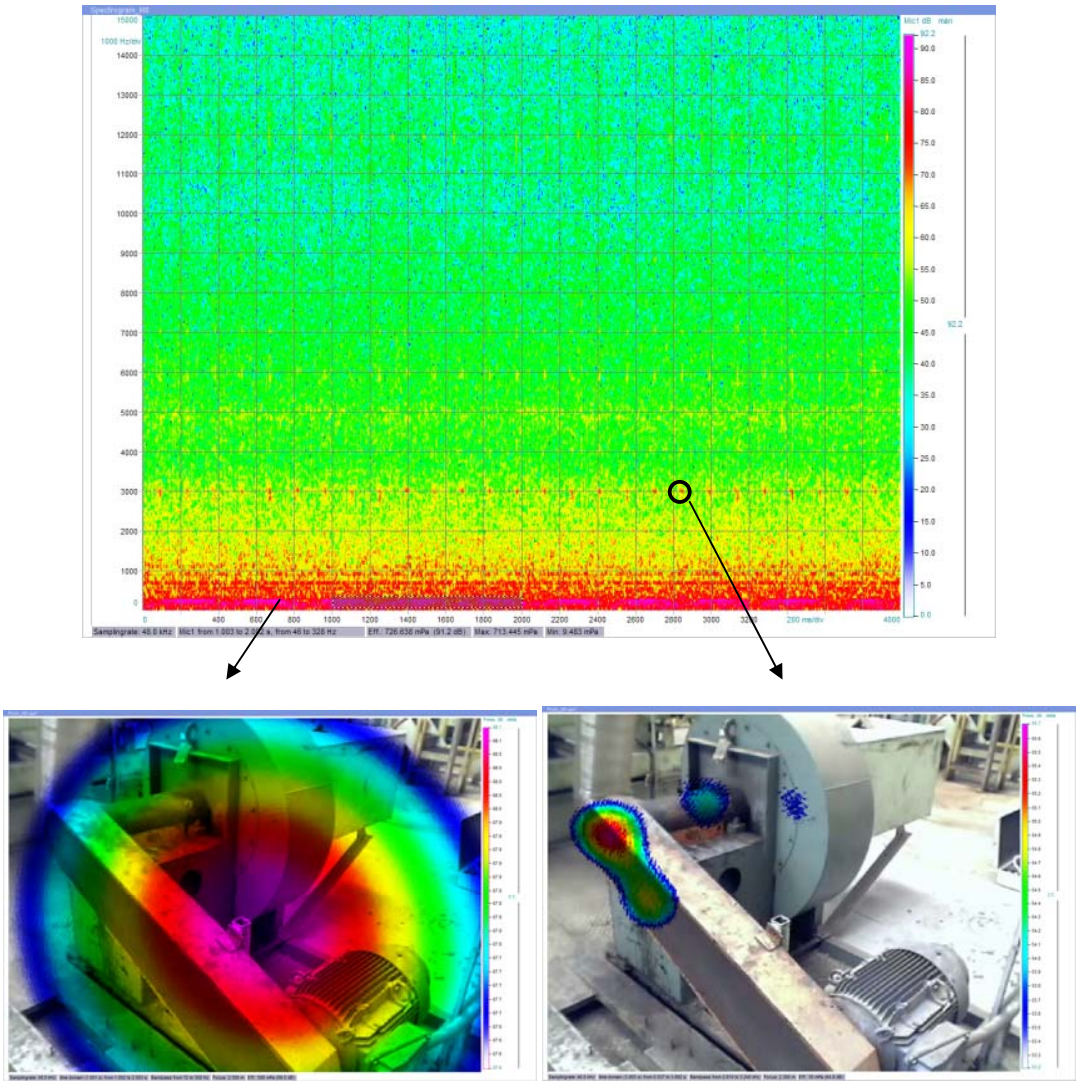

Figure 5: Spectrogram and acoustic pictures

Next pictures presents application of acoustic camera for measurement in the exterior.

Figure 6: Acoustic photo of tanks in stone guarry

4 CONCLUSION

By the use of Acoustic Camera in field measurements it is possible to localize different sources, even with other dominating sources present. It is possible to cover a large number of measurements per day if one makes proper preparations. The measurements results from the Acoustic Camera shows good correlation with sound level meter measurements, after applying correction. By the use of the various new evaluation possibilities such as Acoustic Photo, Acoustic Movie and Spectral Frames it is quite possible to localize noise sources, also when these do not really dominate the overall levels.

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