# 2D Outdoor Measurement

## The Acoustic Camera for Environmental Noise Analysis and Heavy Equipment

### CHALLENGE

Residents living in Welzow near the mining bridge were complaining about environmental noise. In order to reduce noise pollution, the acoustic sources of the bucket-wheel excavator needed to be localized.

### SOLUTION

The Acoustic Camera as a mobile system allows high flexibility for outdoor measurements. Fast measurement and quick analysis enables users to easily identify sources as well as additional measurement positions of interest. With complete measurement set-up and postprocessing of the data, it takes only a few hours to completely identify the loudest sources on large machinery. The sound sources on the excavator can be precisely identified without stopping its operation. Once these sound sources are localized, they can be eliminated to reduce the effects of noise pollution.

### BENEFITS

- Fast and easy set-up
- No expensive machine downtime
- Long distance measurement capability
- Mobile system for flexible measurement locations
- Advanced algorithms for precise localization

### MEASUREMENT

| | |
|---|---|
| **Measurement object** | Strip mining excavator |
| **Microphone array** | Star48 AC Pro |
| **Software NoiseImage 4** | Acoustic Photo 2D<br>Recorder Interface<br>Spectral Analysis<br>Advanced Algorithms |
| **Data acquisition** | Data recorder mcdRec |

The Acoustic Camera was set up as a mobile system for full flexibility using a Star array with 48 microphone channels. After an overview measurement from 150 meters away, the acoustic hot spots were localized. After the quick overview analysis, additional measurements were conducted closer to the sound sources for a more detailed analysis.

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**RESULTS**

For a reliable sound analysis, background noise was minimized by applying A-weighting to all data. In the first measurement from 150 meters distance, the main sources could be easily identified. In Figure 1 the powerhouse and the derrick jib clearly stand out as the loudest areas.

The second measurement (Figure 2) was conducted closer to the derrick jib. As result of this measurement, the redirection point of the jib was identified as one of the loudest sources. A third measurement was made from a position on the bank with direct view to the jib. Several additional measurements were conducted from that position. A detailed analysis in the frequency domain was conducted using advanced algorithms in software NoiseImage.

The analysis using the HDR algorithm (High Dynamic Range) shows different sources and reflections on the ground within a dynamic of 35 dB(A). In the spectrogram (Figure 3), the "banging" sounds are clearly visible. In order to find their location, these areas are simply marked as basis for the calculation region of the acoustic photo. The sound sources can be precisely identified as shown in Figure 4. The broadband rattle sounds were produced by the shovel guides impacting the guide block just below the point of redirection.

**Fig. 1:** Left: owerhouse and derrick jib, right: derrick jib

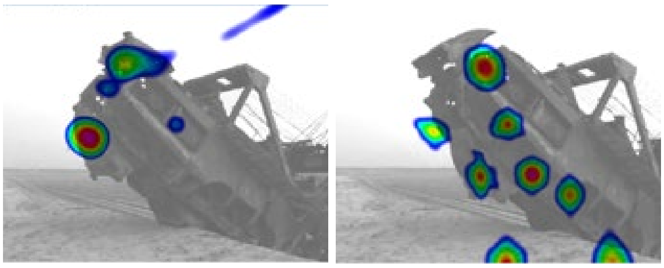

**Fig. 2:** Direct view of the derrick jib

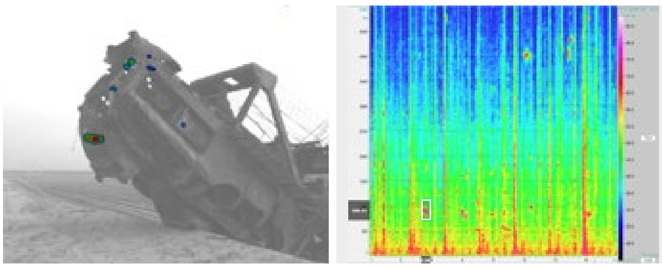

**Fig. 3:** Acoustic photo and spectrogram with a marked frequency range of 700 Hz – 1.1 kHz

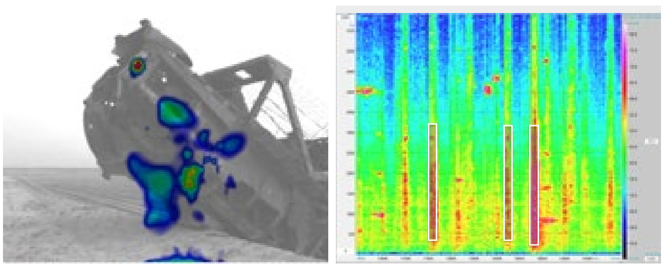

**Fig. 4:** Acoustic photo and spectrogram with a marked frequency range of 400 Hz – 3.2 kHz



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