Environmental Noise Compass -
A New Approach to Directional Noise Monitoring

The latest noise monitoring system in development at Acoustic Research Laboratories Pty Ltd (ARL) employs an innovative approach to the age old problem of directional noise measurement. ARL have combined advanced acoustic signal processing methods, employed for decades in complex military sonar systems, with a multi-microphone array allowing calibrated noise level and compass bearing information to be determined.

The multi-octave array comprises three nested horizontal planar sub-arrays each containing sixteen microphones as illustrated in Figure 1. The spatial filtering provided by each sub-array is specifically optimised for operation in three separate low frequency octave bands.

The noise signals received by each of the nested sub-arrays are processed using conventional time domain beamforming techniques. A total of 216 beams are produced by the beamformer, covering the full range of compass bearings in each octave band.

The spatial filtering provided by the beam pattern is highly dependent on microphone array geometry. In the design of any receiver array, trades-offs are necessary between array maximum size and microphone count. The sixteen element sub-arrays selected for the Noise Compass yields the beam pattern illustrated in figure 2.

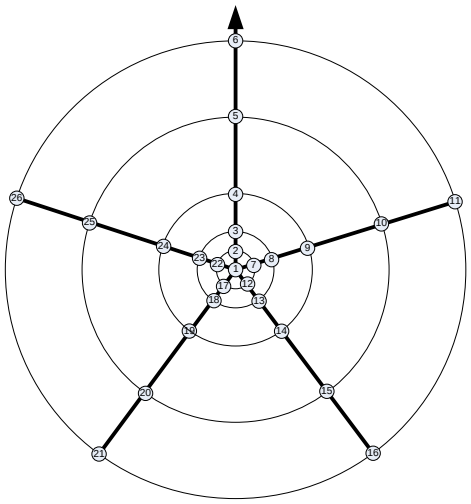

Figure 1 - Microphone Array Layout

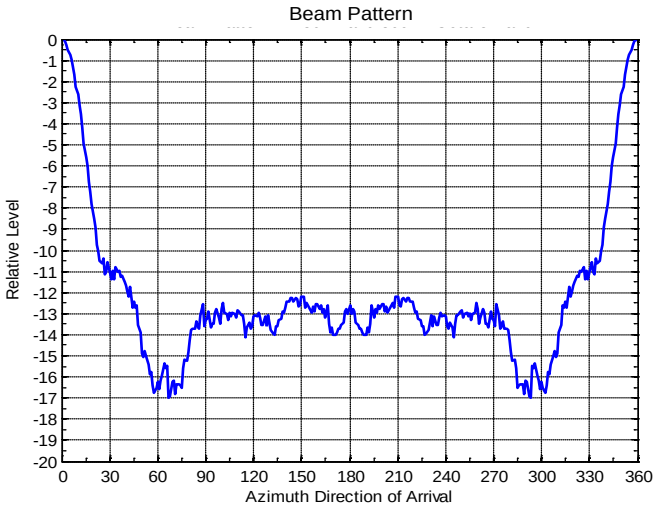

Figure 2 - Beam Pattern

Each beam output is a time-domain signal representing a particular 'look' direction in a designated frequency band. These directional signals are processed using high-speed classical sound level measurement algorithms based upon ARL's Firefly acoustic processing, enabling reliable measurement of multiple simultaneously emitting noise sources.

The processing also supports calculation of interval-based percentile statistics (including L_{eq}) for every directional beam as well as the standard omni-directional measurements.

All system components can be calibrated and maintained to relevant sound level meter standards. This includes the octave band filtering used in the time domain beamforming, thus supporting calibrated directional measurements.

In operational use, the Noise Compass system automatically conducts microphone serviceability checking and reporting, and due to the large number of sensors, degraded mode operation is possible with up to three failed microphones. Support functions include automated report generation, alarm condition triggering and real-time IP streaming of directional audio and noise levels.

The noise compass array can be used to manage generated noise, in particular mining noise. Due to its directionality, centre operators have the capability to view real time sound pressure level information overlaid onto aerial photographs, giving a quick indication of where the possible noise sources are (and at what frequencies).

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