Course: MSc in Environmental and Architectural Acoustics
Unit: Measurement and Behaviour of Sound
Subject: Octave Band analysis with a Sound Level Meter

Aim: To take a frequency analysis of a sound source in octave bands

Instrumentation:

1. SLM (CEL 593 or 328)
2. Calibrator
3. Tripod
4. Sound Sources (fan)

Introduction

These SLMs are fitted with internal filters units so that an octave band analysis of the sound can be made.

Octave bands are a convenient way of dividing the aural spectrum (20 Hz to 20 kHz) into "chunks". The musical relationship of octaves has been known for centuries and scientifically the octave is defined as the interval between two frequencies, the upper frequency being twice the lower frequency i.e $f_{upper} = 2 * f_{lower}$
The name of the octave band is given by the geometric-mean frequency

$$f_{mid} = \sqrt{f_{upper} * f_{lower}}$$

e.g in the 22 Hz to 44 Hz octave band the mid-frequency is 31.5 Hz.

To avoid confusion, internationally agreed preferred octave bands are used, and the filter unit is so arranged.

Task

Measure octave band and the overall "A" and "Linear" weighted sound pressure levels (SPLs) of a noise source in the anechoic chamber at at least two different locations approximately 1m from the source,

Carry out the same measurement in the reverberation chamber.

If time allows, repeat the same test with a different SLM.

Notes

- Calibrate the SLM first using a calibrator or a pistonphone.
- Carryout the measurements in all octave bands between 31.5 Hz and 16 kHz.
- Plot the octave bands analysis of the noise

- Use the following setting with the CEL 328: F (Fast) FL (Frequency Linear) for the octave band measurements and A (A-weighting) for overall measurement; do not use FA (Frequency and A weighting)

Questions

1. In what octave band does the maximum SPL occur?
2. Why should a smooth curve not be used to join the points?
3. Explain the difference (if any) between SPL (overall “A”, “L” and in octave bands) in anechoic and reverberation chamber?
4. Would you expect the same reading if the meter was moving at the time of the measurement?
5. Do you notice that the instantaneous octave band level at low frequency (say 125 Hz) changes while the high frequency (say 4 kHz) does not? Why?
6. Now set filter to 400 Hz and obtain the characteristics of the filter. Repeat for 500 Hz and 630 Hz.

PART B Measurement of frequency weighting using random noise (time allowing)

An alternative is to use broad band noise as the source and measure the change in level at the various frequencies when a weighting network is switched on. A broad band noise source produces all the frequencies in equal proportions simultaneously, so that the resulting signal is noise. “Pink” noise is a special form of noise use for octave band analysis.

1. Connect the output of the B&K 1402 or Rion DF04 random noise generator to the input of the B&K 2131 digital filter analyser.
2. Set B&K 2131 as follows (light on=on): input direct, A weighting off, averaging time 1s, exponential averaging, frequency range 25 Hz – 20 kHz, 1.3 octave, analog input.
3. Set the B&K1402 as follows: meter time constant to 5sec, frequency response to pink noise, matching impedance to attenuator, external filter- “out” (no signal will be present if “in” is selected and no external filter is connected), output level to 1 and adjust attenuator to obtain a suitable value without overloading the analyser.
4. There should now be a slight fluctuating, flattish spectrum; to improve the accuracy increase the averaging time to 8 sec or 16 sec, when the spectrum is stable press hold and use the channel selectors to read the level. Use these levels as reference for the next measurement.
5. Change the averaging time to a much shorter time and press A weighting button on the B&K 2131, then go back to the longer averaging time. (Explain the reason for temporary change of averaging time). Read the levels in the same manner as in 4). Difference between these reading and levels obtained in 4.) should give you A weighting curve.

Data to be presented

1. Plots of A, B, C & D weightings.
2. On a copy of you're a weighting characteristic plot the ideal A weighting characteristic. Question: should it be 1/1 octave band of 1/3 octave ideal A weighting data?
3. Shape of 1/3 octave filters as measured in 9) of PART A. Determine the effective bandwidth of the filter at the 3 dB down points and the ripple value.