Urban Physics, 7S0X0

Urban Acoustics, Exercises week 3

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1) Is each of the following statements wrong or right:
   a) Road traffic is the most dominant and most annoying source of environmental noise;
   b) The 1000 Hz frequency peak in the spectrum of road traffic noise is caused by tyre-road noise;
   c) Aerodynamic noise around the body of road vehicles is the second most dominant source of noise of road vehicles;
   d) The noise from aerodynamic sources of trains rapidly increases with the train speed;
   e) Noise maps produced according to the END should include aircraft noise;
   f) Aircraft noise is regarded as the most annoying source of transportation noise sources;
   g) Noise maps have been developed for wind farms in the context of the END;
   h) The problem with wind turbines it its low frequency components;
   i) At a long distance from a line source of finite length, the sound pressure level from the line source decays with 6 dB with doubling the distance to the line source;
   j) The sound power from a point source reduces with distance from the source.

2) Plans are made to build a residential area close to a highway. To analyse the noise level due to the highway in this area, you need to compute the noise level at a position 50 m and a position 100 m away from the highway.
   a) Assume that the highway is very long and straight. The averaged sound power level from this highway has been estimated at E = 91.5 dB(A). Compute the sound pressure level in dB(A) at the two receiver points. Neglect the effect of the ground.

50 m at the other side of the road, a small industrial building is located. The building produces a high noise level and the sound power is estimated at E = 111.1 dB(A).

   b) Compute the total noise level at the two receiver positions from the highway and the industrial building, while considering the building as a point source. The distance to the building can be considered equal as the distance to the road. Explain the sound level difference between the two receiver position compared to the answer of 2a).

To reduce the noise in the area, you have found information on the reduction of noise by a noise screen, see Figure 1. To assess the potential reduction of noise by the screen for road traffic and the industrial noise source, you also have access to the power spectra of the road traffic and the industrial building, see Table 1.

c) Explain whether the noise screen is more effective to reduce noise from road traffic or from the industrial building.

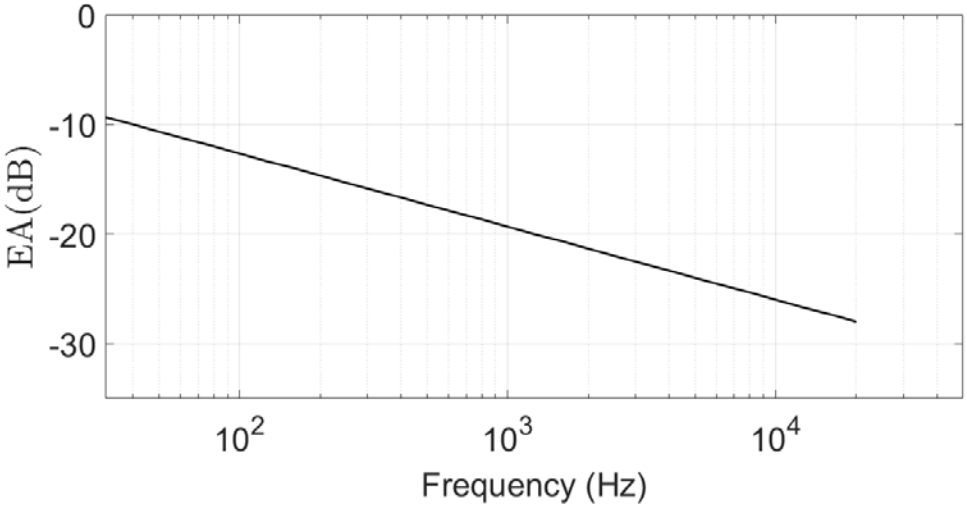

Figure 1. Spectral effect of a noise screen expressed by EA (Excess Attenuation) in dB: a negative EA value means a reduction of noise.

Table 1. Spectral values of the sound power from the road and industry building.

Octave band middle frequency (Hz)	E_{road} (dB(A))	$E_{industry}$ (dB(A))
63	61	95
125	67	110
250	75	104
500	79	90
1000	88	85
2000	88	85
4000	81	83
8000	73	80

3) Two different wind turbines are location 300 from each other. You need to calculate the distance dependent sound level in the direction of a residential area. The second wind turbine is always 300 m further away than the first turbine in this direction. You plan to measure the sound pressure level at some points and extract the sound power level from the two turbines using this data. Once you have the sound power levels, you can compute the sound pressure level at all possible distances from the turbines. How many measurements are needed in this strategy. Consider the wind turbines as point sources and neglect the ground effect for simplicity.