Vehicle Acoustics

Exercise 1

Questions 1 - 6

Aufgabe 1

How much higher is the sound pressure level, if the sound pressure…

a) is increased by factor 3?

b) is doubled?

c) is increased tenfold?

Solution

a) The sound pressure level rises by 9.54 dB   for a increased sound pressure by factor 3.

b) The sound pressure level rises by 6 dB   for a doubled sound pressure.

c) The sound pressure level rises by 20 dB   for a tenfold sound pressure.

Aufgabe 2

To calculate the overall level of two different sound sources it is possible
to sum up the **higher sound level L_H** and the **additional level L_A**.

a) Deduce from the general formula for the addition of sound pressure levels for two incoherent sound sources
   the formula for the **additional level L_A** as a function of **ΔL**.

b) Draw $L_A = f(\Delta L)$ in a diagram (abscissa 0 – 20 dB in steps of 1 dB).

Solution

- $L_A = 10 \cdot \log\left(1 + 10^{-0,1\cdot\Delta L}\right)$
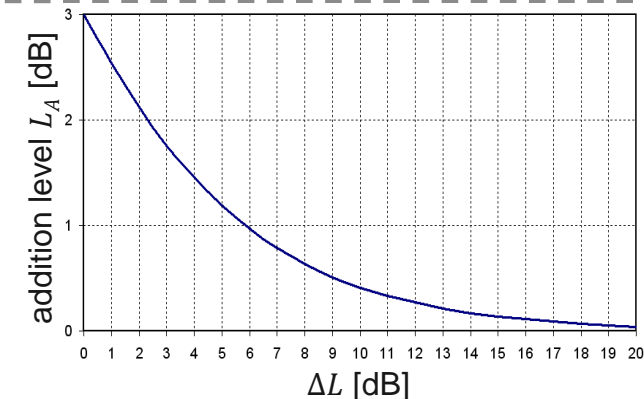
Aufgabe 3

The horn of a passenger car produces a sound pressure level of **92 dB**.

Please determine the overall sound pressure level if an additional horn with **85 dB** is used.

Compare the result with the diagram of question 2.

Solution

- Computational solution:
$$L_{total} = 92,79 \text{ dB}$$

- Graphic solution:
$$L_A \approx 0,8 \ dB \ \Rightarrow \ L_{total} = 92,8 \text{ dB}$$

Geräuschmessungen an drei identischen Motorprüfständen in einer Halle ergeben einen **Gesamtpegel** von **93 dB**.

Nachdem an zwei Motoren die Lichtmaschine ausgebaut wurde, ergibt sich ein **Gesamtpegel** von **92 dB**.

Um welchen Betrag **ΔL** wird der Pegel **eines** Motors durch den Ausbau der Lichtmaschine abgesenkt?

Solution

- Sound pressure level of one engine <u>including</u> the generator:

$$L_i = 88,23 \text{ dB}$$

- Sound pressure level of one engine <u>excluding</u> the generator :

$$\tilde{L}_i = 86,63 \text{ dB}$$

Aufgabe 5

In order to determine the sound pressure level of a passenger car at standstill the following levels were measured at specific positions around the vehicle:

$$L_1 = 80 \text{ dB(A)} \qquad L_2 = 78 \text{ dB(A)} \qquad L_3 = 74 \text{ dB(A)}$$

$$L_4 = 76 \text{ dB(A)} \qquad L_5 = 77 \text{ dB(A)} \qquad L_6 = 73 \text{ dB(A)}$$

Please calculate the **energetic average** value as well as the **arithmetic average** value of the measured sound pressure levels.

Solution

- Energetic average value
    $$L_m = 76{,}96 \text{ dB}$$

- Arithmetic average value
    $$\bar{L} = 76{,}33 \text{ dB}$$

Aufgabe 6

Please illustrate the characteristics of

- a tone
- a sound
- a noise
- an impulse

based on sound pressure diagrams in the **time** and **frequency** domain.