

COSC 4P98 Lecture notes: **Decibels**

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B. Ross

- *Amplitude*: sound pressure displacement, above and below equilibrium.
 - air pressure change (eg. psi, pounds per square inch)
 - can be voltage for electric analog signals
- Sound pressure is very small. If atmospheric pressure is 15 psi, then a loud sound causes a deviation from 14.999 to 15.001 psi.
- But human ear is very sensitive. Ratios between amplitudes for soft and loud sounds is in the millions.
- A decibel (dB) scale is used:
 - decibels = $20 \log_{10} R$: where R are measurements of sound pressures
 - logarithm converts large-scale unit measurements into smaller, linear scale: easier to use.
- There is a zero reference for dB:
 - 0 dB = 0.0002 dyne/cm²
 - This is a very quiet environment.
 - Then sounds can be measured by their relative increase in decibels from this value.
 - This use of dB is called SPL (acoustic Sound Pressure Level).
- Example:
 - You have a motorcycle that has an SPL of 80 dB. You then add another motorcycle. This means the ratio $R = 2$.
 - Then $20 \log (2) = 6.02$ decibel.
- Note that measuring amplitude is complicated by many factors: units of measurement, ambient temperature, altitude (barometric pressure), etc.
- The main thing to note: adding 6dB means the sound seems twice as loud.
- Example:
 - A busy street has a SPL of 70 dB. A Motorhead concert has an average SPL of 130 dB. Therefore, Motorhead seems about $(130 - 70) / 6 = 10$ times louder than the busy street.

References

Principles of Digital Audio (4e), Ken C. Pohlmann, McGraw Hill, 2000.