

Notes Lecture 7 HSP

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1 Pre-lecture

Preparation: Read chapter 10

- What is a periodic sound wave and can you give some examples of periodic sounds?
*Waves, in which the cycles of compression and rarefaction repeat in a regular or periodic fashion, as opposed to aperiodic waves (Turbulent events, e.g. door slam), and example of a periodic sound wave can be a tuning fork. The most simple periodic sound wave is a **pure tone**, in which the wave corresponds to a sine-wave in the mathematical formula context.*
- What is a complex sound?
A sound where the air-pressure of the sound-wave over time is complex or very irregular???
- What is the physical measure (closest) corresponding to perceived pitch?
Frequency
- What is the physical measure (closest) related to a sound's loudness?
Amplitude
- What do the equal loudness curves tell us?
*All the tones specified in the curve, are equally loud, even though the dB SPL(Amplitude) and Frequency(Hz) differs.
More info: Sensitivity over frequency of tones, E.g. a 10 dB louder frequency wave but is on a frequency of 0.1, sounds just as loud as a 1kHz frequency on a dB of 50*
- What is shown in a frequency spectrum?
*The frequency spectrum of an electrical signal is the distribution of the amplitudes and phases of each frequency component against frequency.
(<https://www.collinsdictionary.com/dictionary/english/frequency-spectrum>)*
- What are the ossicles and why do we need them?
The three smallest bones in the human body, they transmit sound energy from the tympanic membrane to the inner ear. (Malleus, Incus, Stapes), it's specifically the Malleus that is connected to the tympanic membrane.
- What is the basilar membrane doing to help differentiate high and low frequencies?
The basilar membrane separates out frequencies of the sinusoidal components of a complex wave, the stiff base of the membrane responds most readily to high frequencies, whereas the apex responds to low frequencies because it's more flexible.
- What are the inner and outer hair cells and what do they do?
The inner haircells are responsible for transducing sound into neural signals, and the outer hair cells serve to amplify and sharpen the responses

of the inner hair cells. Both are crucial parts of the corti, along with the tectorial membrane.

- How is phase synchronization used in auditory signalling?
A phase refers to the time-displacement of one wave, e.g. two waves in different phase has two different "locations" on a graph, either + or -. Something about frequency hitting at the same time as the AP from neural signals ???

2 Lecture

3 Knowledge

- Explain what sound is and how the auditory system detects it
Pressure-waves (vibrations) of specific amplitude and frequency. Only through matter.
- Describe some basic operating characteristics of the auditory system (Audibility thresholds, perceived loudness for different frequency ranges). *Audibility threshold; Variations over the span of frequencies, it depends on the frequency. Perceived loudness for different frequency ranges; e.g. low vs high frequency needs a dB boost to make it equal in loudness*
- Give examples of sounds that have a defined pitch *Vowels, A whistle, tuning fork. Guitar string; defined pitch is a periodic wave. all periodic wave have a harmonic spectrum, which gives rise to a defined pitch. Examples of sounds that do not give defined pitch; white noise, traffic noise, noise. Something like a drum is hard to agree on a tune for.*
- Give examples of when masking occurs *Temporal masking; one loud sound and then a short sound afterwards, the loud tone can mask the weaker one. the same with instruments e.g. basoon masking a piccolo if the basoonist play loudly.*

4 Important notes

- What is sound?
Movement that disturbs air-molecules, which then collides with other molecules, this then causes changes in air-pressure which propagates outwards.

Pure tone has one frequency. Which is related to sin-wave or cos-wave

Relationship between sound speed:

$$v = f \cdot \lambda$$

Where v is the m/s, f is the frequency and lambda is the meters

All sound waves can be described with the sinoids

Combining a high-amp low-freq wave with a reverse feature wave, gives a period?

Which we perceive as two tones. But the combined tone will have a fundamental parent, either one of the waves having the same cycle.

Complex waveforms are usually square in a graph because it's very detailed in the waveform.

How can we utilize auditory masking? Compression and Audio coding.