

ECS614U/ECS749P: Sound Recording and Production

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`http://qmplplus.qmul.ac.uk/course/view.php?id=3243`

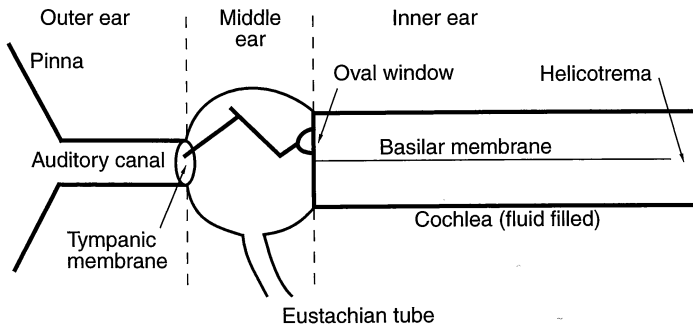
Centre for Digital Music
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Psychoacoustics

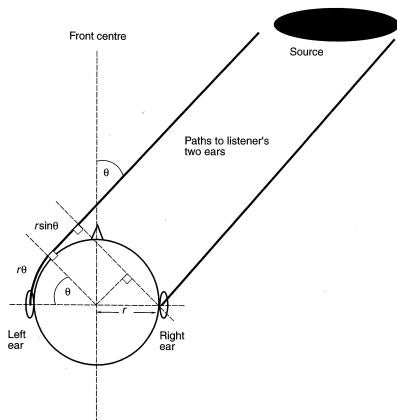
- Psychoacoustics is the study of sound perception.
 - Space.
 - Timbre: brightness, warmth, roughness, pitch.
 - Loudness and masking.
- How does the physiology of the auditory system work?
- How does our brain interpret the signals that it provides?

Simplified Diagram of the Human Ear



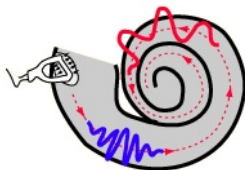
- Auditory Transduction Video

Spatial Perception

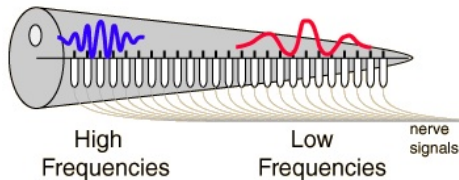


- Sound source is closer to right ear than left.
- Interaural intensity difference (IID).
- Interaural time difference (ITD).
- Sound is filtered by the shape of our outer ear and decoded by our brain (modelled using HRTF).

Place Theory of Pitch Perception

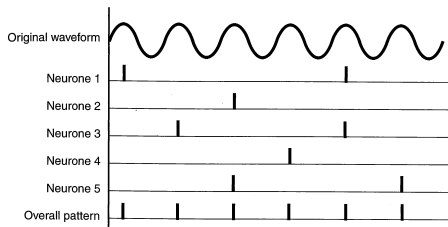


- Different parts of basilar membrane respond to different frequencies.



- Frequency is decoded from place of activation.

Temporal Theory of Pitch Perception

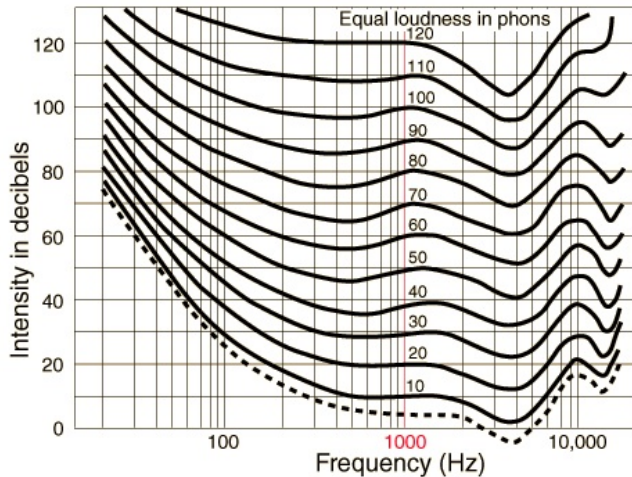


- Frequency is decoded from overall nerve firing pattern.

- The fundamental perceptual feature of a sound is its loudness.
- Loudness is the **perceived** intensity of a sound.
- It is different from the **objective** measure of sound intensity.

- Loudness is a function of:
 - The absolute sound pressure level.
 - The spectral properties of the sound.
 - The time-domain properties of the sound.

Equal Loudness Curves



The Effect of Listening Level

- The relative loudness of sounds at different frequencies will change with the listening level.
- The loudness balance in a mix will also change with listening level!

Loudness with duration

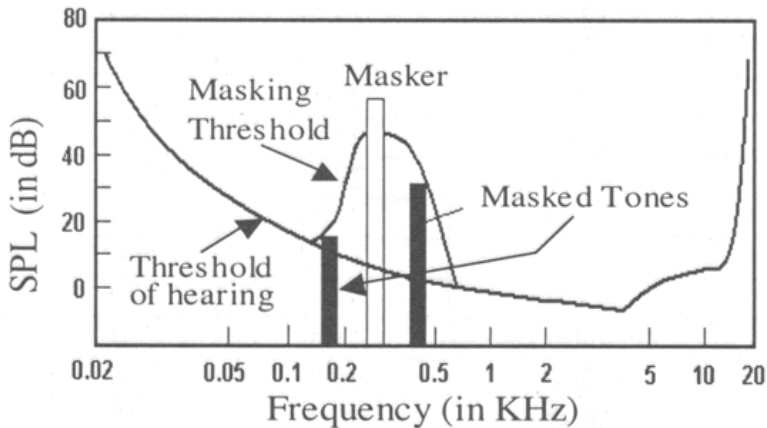
- It takes a finite amount of time for the ear to react to a sound, so loudness is accumulated over time.
- It takes around 200 ms for loudness to fully accumulate, so sounds of shorter duration are quieter.

The Loudness of Musical Sounds

- Musical sounds are time-varying, so it is more difficult to compare their loudness.
- The loudness of transient sounds, e.g. drums, is related to the peak loudness over time.
- The loudness of steady-state sounds, e.g. synth pad, is related to the mean loudness over time.

- Masking is the phenomena by which the loudness of a sound is reduced when heard in the presence of other sounds.

Masking



- The loudness of a sound when masked by other sounds is known as the partial loudness.
- Masking is a function of:
 - The absolute sound pressure level.
 - The spectral properties of the sounds.
 - The time-domain properties of the sounds.

Stream Segregation

- When we listening to a mixture of sounds, our brain groups or segregates them into streams, based on their original acoustic sources.
- Our ability to segregate is promoted by salient features of the sounds, e.g. spectral and temporal differences.
- A 'clear' sounding mix likely contains sound-streams that are easy to segregate.

Psychoacoustics and Audio Production

- We balance the loudness of sounds, and control the interactions between them, using audio production tools.
- In doing so, we are manipulating and modifying the psychoacoustic effects discussed in this lecture.
- All of these effects are highly dependent upon the listening level!