

Acoustics of Speech and Hearing

Lecture 8
Audio Recording

Overview

1. Why do we need to record speech?
2. The recording chain
3. Measuring quality
4. Audio recording components
5. Recording tips

1. Why Record Speech?

- Off-line analysis
- Instrumental analysis
- Permanent record
- Distribution

2. Recording Chain

- Chain of component **systems**:
– microphone ⇒ pre-amplifier ⇒ recorder ⇒ storage medium ⇒ player ⇒ amplifier ⇒ speaker

System	Input	Output
<i>Microphone</i>	Sound	Electrical signal
<i>Amplifier</i>	Small electrical signal	Large electrical signal
<i>Recorder</i>	Electrical signal	Magnetic pattern on tape
<i>Player</i>	Magnetic pattern on tape	Electrical signal
<i>Speaker</i>	Electrical signal	Movement of cone

Series of transformations between physical forms

Recording Chain

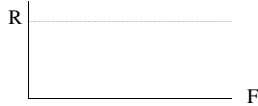
- Each system in chain can change signal
- Overall quality is combination of quality of parts:
 - “Chain only as strong as its weakest link”
- How can we measure the quality of component systems?
- What makes a good system for recording speech?

3. Measuring Quality

- Three main parameters:
 - Frequency Response
 - Signal to Noise Ratio (SNR)
 - Harmonic Distortion

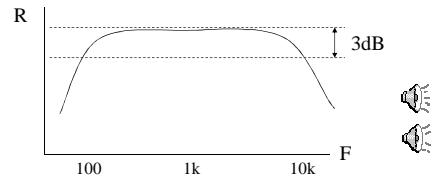
Frequency Response

- Ideally each component system should not change the spectral content of the signal
 - it should pass all sinusoidal components of the signal equally
 - it should have a flat frequency response graph



Frequency Response

- Frequency Response required for Speech
 - Should pass frequencies from about 100Hz to 10,000Hz with little change (within 3dB)



Signal to Noise Ratio (SNR)

- Ratio of amplitude of **signal** to amplitude of **noise** generated by recording system

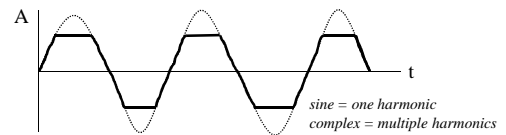
$$\text{Signal to Noise (dB)} = 20 \log_{10} \left(\frac{\text{Signal Amplitude}}{\text{Noise Amplitude}} \right)$$

- For speech need at least 50dB, preferably more
- Noise noticeable until 80dB SNR



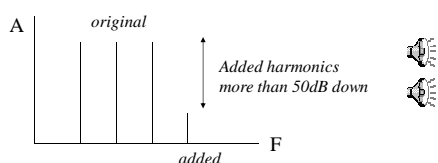
Harmonic Distortion

- Distortion arises from **irreversible change** to signal shape
 - Introduces new components (harmonics) into spectrum
 - E.g. Peak clipping on over-large signals



Harmonic Distortion

- Distortion of periodic signals shown by introduction of new harmonics
 - For speech, good to have distortion below 0.3% or each added harmonic more than 50dB lower than true harmonics



4. Audio Components

- Microphones
- Audio Recorders

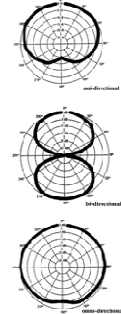
Microphone Type

- Crystal (piezo crystal):
 - poor quality
 - large output
- Dynamic (moving coil):
 - moderate quality
 - large output
- Condensor/Electret (capacitor):
 - high quality
 - small output



Microphone Directionality

- Uni-directional
 - single sound source
 - noisy environment
- Bi-directional
 - two sound sources
 - conversation
- Omni-directional
 - multiple sound sources
 - meeting



Audio Recorders

- “Voice” Recorders
 - × internal microphone
 - × poor audio quality
 - × analogue interface
- Audio Cassette Recorders
 - ✓ external microphone
 - × moderate audio quality: tape hiss & distortion
 - × analogue interface



Audio Recorders

- Minidisc Recorders
 - ✓ external microphone
 - ✓ good audio quality
 - × analogue interface
- Digital Audio Recorders
 - ✓ external microphone
 - ✓ excellent audio quality
 - ✓ digital interface



Buying an Audio Recorder

- Look for:
 - external microphone input
 - manual record level control
 - ease of operation
 - USB interface
- Audio advice on the web:
 - <http://www.phon.ucl.ac.uk/resource/audio/>

5. Audio Recording Tips 1

- Environment
 - quiet surroundings
 - soft furnishings
- Microphone
 - always use external microphones
 - choose directionality
 - within 1 metre of speaker
 - tie clip microphone useful
 - out of air stream



Audio Recording Tips 2

- Audio Recorder
 - best you can afford
- Recording Levels
 - set recording levels carefully
 - monitor recording for overload
- Cassette Tape
 - Type II (chrome) superior

Audio Recording Tips 3

- Operation
 - keep notes about recording
 - speak introduction onto tape?
 - label tape
 - record footage
- Analogue Recorder Maintenance
 - clean tape heads & rollers occasionally
 - keep tapes away from heat and magnetic fields

Summary

- Tape recording chain
- Measuring quality for speech recording
 - Frequency Response
 - Signal to Noise Ratio
 - Harmonic Distortion
- Choosing microphones & recorders
- Tips for good recording

Lab Experiment

- How to making good speech recordings
- Try some different audio recorders
- Record some different types of material
- In some different recording environments
- Compare quality of recorders and recordings



Tuesday 4 December

- 0900-1000 Review Lecture
- 1000-1230 Recording Session 1
- 1300-1400 End of term Quiz
- 1400-1630 Recording Session 2