

Review of *Audio* and Speech Processing

Introduction



Review: Audio and sound

- Q1: The human auditory system is most sensitive in which frequency range?
 - A) 500 Hz to 5000 Hz
 - B) 20 Hz to 20,000 Hz
 - C) 7 Hz to 50,000 Hz
 - D) Below 20 Hz only
- Q2: Why is infrasound considered dangerous to humans?

Review: Timbre and pitch

- Q1: What is a complex sound? Explain the concepts of partials, fundamental frequency, and harmonics.
- Q2: Define timbre and explain how it differs from pitch or intensity.

Review: Audio and Fourier transform

- Q1: A sound wave has a period $T = 0.001$ seconds, and amplitude $A = 0.3$. Calculate the frequency f . Sketch the time domain figures and the frequency domain figures.
- The purpose of the Fourier transform.
- Q2: Test your function on a synthetic sinusoidal signal. Generate a signal x with $N=1024$ samples, frequency $f = 440$ Hz (A4 note), sampling rate $sr = 44100$ Hz.
- Compute the magnitude spectrum with the function $X_mag = np.abs(my_dft(x))$. Plot the magnitude spectrum vs. frequency ($f = np.linspace(0, sr/2, N/2)$)
- Interpret the generated figures according to your understanding (e.g., peak location interpretation)

Review: Audio and Fourier transform (continue)

- Q3: Given an audio signal file, write code to obtain its sampling frequency, and play the audio file.
- When the sampling frequency is two times higher, what is the impact on the audio file?
- Generate the Fourier spectrum of the signal.
- When the sampling frequency is two times lower than the original, what is the impact on the audio file?

Reference

- A. V. Oppenheim, and A. S. Willsky. Signals & Systems. Pearson Education, 2013. (Chapter 1-3, 5, 7)
- L. R. Rabiner, and R. W. Schafer, Introduction to Digital Speech Processing, Foundations and Trends in Signal Processing 1 (1-2), 1-194, 2007.