Psychoacoustics

Pantelis N. Vassilakis Ph.D.

Module 5 Homework (Pitch)

Student Name: _____

1) (*36pts*) **Indicate whether the statement is true or false by printing T or F** .

_____ The pitch of two complex harmonic tones with the same fundamental frequency and components up to 5000Hz may not be the same because of differences in the number of their harmonics above the fundamental.

_____ The place theory of pitch perception is well supported by experiments, where the fundamental frequency is masked or missing altogether.

_____ Phase locking, firing synchrony, and volley are all related to temporal theories of pitch perception.

_____ The range of maximal pitch accuracy extends ~seven octaves above ~60Hz (~B1), to ~7600Hz

_____ We can still identify pitch height and recognize pitch direction changes for frequencies up to 10kHz.

_____ As frequency f increases, equal pitch distances ΔP correspond to increasingly larger frequency distances Δf so that the ratio $\Delta f / f$ remains constant.

_____ A flat mistuning tends to be perceived as more forgiving than a sharp mistuning.

_____ When singers reproduce octave intervals in solo performance, they are more likely to reproduce them stretched.

_____ For ΔP = one octave, $\Delta f / f = 3$.

_____ Introducing a loud low note in the cellos while a flute is performing a quiet high note will probably shift the perceived pitch of the flute note downwards.

_____ Increasing the intensity of a 250Hz pure tone will probably shift its pitch downwards.

_____ A sinusoidal signal must last for at least 100ms before a clear sense of pitch is portrayed.

2) (*4pts*) **Pitch discrimination in humans occurs in the order of**

a) 1/10th of a critical band.

b) 5:4 of a semitone.

c) ~ a 3rd-octave band.

d) 1/12th of a semitone.

3) (*5pts*) **The two main competing theories of pitch perception are**

a) tonotopic theories and periodicity theories.

b) temporal theories and masking theories.

c) mel theories and loudness theories.

d) timbral theories and displacement theories.

4) (*4pts*) **A unit for pitch is**

a) seconds.

b) Hz.

c) mels.

d) meters per second.

5) (*4pts*) **For fundamental frequencies up to ~2-3kHz, our auditory system is able to resolve**

a) all odd harmonics.

b) all even harmonics.

c) the first 7 to 10 harmonics.

d) the last 5 harmonics.

6) (*4pts*) "**Interference" from a low frequency signal will induce to a high frequency signal**

a) a downward shift in pitch.

b) an upward shift in pitch.

c) no shift at all.

d) first an upward, then a downward shift in pitch.

7) (*5pts*) **At least two of the dimensions of pitch are**

a) height and loudness.

b) frequency and duration.

c) time and height.

d) height and chroma.

8) (*4pts*) **An increase in intensity**

a) always results in a decrease in pitch.

b) doesn't affect pitch at all.

c) always results in an increase in pitch.

d) can affect pitch either by increasing or decreasing it depending on frequency.

9) (*4pts*) **For harmonic complex tones, their spectral frequency region responsible for the resulting pitch is**

a) the region where the fundamental frequency (present or missing) lays.

b) the region above the 10^{th} component, where the individual components are not resolvable by the basilar membrane.

c) the region between 400-1500Hz, for low-to-mid fundamental frequencies.

d) all of the above, depending on the fundamental frequency and spectral distribution of the complex tone in question.

10) (*5pts***) Analytic listening is a term describing**:

a) a type of listening based on systematic and controlled analysis of the context accompanying a sonic stimulus, following explicit rules.

b) a type of listening that interprets a stimulus by focusing on an analysis of all its components, following explicit rules.

c) a type of listening that uses appropriate electronic instruments to perform a Fourier analysis on the stimulus listened to, following explicit rules.

d) a type of listening based on music theory analysis of the stimulus listened to, following explicit rules.

11) (*5pts*) **Synthetic listening is a term describing**:

a) a type of listening based on systematic and controlled synthesis of the context accompanying a sonic stimulus, following implicit rules.
b) a type of listening that interprets a stimulus by focusing on it as a whole and comparing it to previous experience, following implicit rules.
c) a type of listening that uses appropriate electronic instruments to perform a Fourier synthesis of a stimulus similar to the one listened to, following explicit rules.
d) a type of listening based on music theory understanding of the stimulus listened to, following implicit rules.

12) (*10pts*) **Fill in the blanks:**

The place theory of pitch, confirmed by _____ in the 1960s, relates the pitch of a sine tone to the _____ on the _____ in the inner ear, and the pitch of a harmonic complex tone to the frequency of the _____ _____ spectral component. To explain cases where pitch corresponds to a _____ on the _____ not stimulated by any of a complex tone's components, this theory relies on the introduction of _____ distortion products and specifically the introduction of the _____ frequency. This explanation is challenged by experiments where stimulation at the pitch-matching place on the basilar membrane is inhibited through _____ or _____. It is also challenged by experiments where, shifting the frequency of the spectral components up/down without changing their frequency spacing shifts the pitch even though the _____ frequency among successive components remains the same. This phenomenon is called the _____ effect.

13) (*10pts*) **Fill in the blanks:**

Periodicity theories of pitch rely on _____ (*time* or *frequency*) information, as represented on the signal itself or through conversion to _____ spikes, following _____ (*Inner-* or *Outer-Hair-Cell*) stereocilia activity.

The temporal theory that assumes pitch to arise from the interaction at a neural level among components that cannot be resolved by the basilar membrane is called the _____theory of pitch and was introduced in the 1930s by _____.

The volley theory of pitch, introduced in the 1940s by _____, explains pitch in terms of the combination of _____ and _____ information from a large number of _____ associated with a specific place on the basilar membrane.

Pattern or 'virtual' pitch theories, such as the one introduced in the 1970s by _____, explain pitch in terms of previous learning that supports the creation of a template of _____ on the basilar membrane.