Music 175: Psychoacoustics
Spring 2017

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Course Information

Teaching Assistant

- Tahereh (Tara) Afghah tafghah@ucsd.edu

Meeting Time and Place

Meeting Dates: 2017/4/4 - 2017/6/8

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>Lecture:</td>
<td>TuTh 12:30PM -1:50PM</td>
<td>CPMC 367</td>
<td>Smyth</td>
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<tr>
<td>Office hours:</td>
<td>Tu 2:00-3:00PM (after class)</td>
<td>CPMC 233 (office)</td>
<td>Smyth</td>
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<tr>
<td>Office hours:</td>
<td>Tu 11:30-12:30PM (before class)</td>
<td>CPMC 367</td>
<td>Afghah</td>
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<tr>
<td>Final Exam (projects):</td>
<td>M 11:30AM-2:30PM (2017/6/12)</td>
<td>CPMC 367</td>
<td>NA</td>
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Course Description


Prerequisites

Music 170 or 171 (or permission by instructor).
Grading

• 3 exams (15% each): 45%
• 1 assigned paper presentation: 10%
• participation and occasional assignments/experiments: 10%
• Final project and presentation 35%

Required Textbooks


• Music 175 on-line notes.

Important Dates

• Thursday, April 20, 2017: Exam 1.
• Thursday, May 11, 2017: Exam 2.
• Thursday, June 8, 2017: Exam 3 (last day of class).
• Monday June 12, 11:30AM-2:30PM: Final project presentations (10-15 minutes each).

Schedule and Online Lecture Notes (subject to change)

• Week 1:
  – Introduction to Music 175
  – Sound:
    * Sound: what is sound? acoustics vs. psychoacoustics.
    * Waves: time representation of sound, sinusoids, partials/overtones, harmonics.
    * Spectrum: frequency representation of sound, fourier analysis, spectrograms, periodicity
  – Pd patches: harmonicity.pd, pitchFreq.pd, pitchFreq.pd
  – Reading: Cook, Chapter 4.
• Week 2:

  – Hearing
    * **Sound Level**: pressure, power, intensity, dB scale
    * **Ear Physiology**: The ear and how it works
    * **Loudness**: phons, sones, Fletcher-Munson equal loudness curves, masking
  – **Pd patches**: [db.pd](#), [FrequencyAndLoudness.pd](#), [max.pd](#)
  – **Reading**: Cook, Chapter 1 and 6.

• Week 3:

  – Hearing in Time and Space
  – **Exam 1** (Thursday, first 45 mins of class)
    * **Time and Space**: “cocktail party”, binaural masking, precedence effect, reverberation, localization.
  – **Reading**: Cook, Chapter 8.

• Week 4:

  – Hearing in Time and Space (cont.)
  – Field trip: **Thursday April 27**, Audio Spatialization Lab (Spat Lab), Calit2.
    * Meet promptly at CPMC 367 at 12:30 (we will walk over together)
    * [Spat Lab map (see room in yellow, 1604A)](#)

• Week 5:

  – Cognitive Psychology and Music
    * **Principles of perception**: unconscious inference vs. direct perception (Gibson), size and loudness constancy, perceptual completion, gestalt grouping principles.
  – **Reading**: Cook, chapter 3

  – **5 student presentations** Hearing in Time and Space (Thursday, first 50 mins):
    1. Dylan Finkbeiner: “A General Model for Spatial Processing of Sounds”
    2. Wesley Chaffin: “Comparative Study of European Concert Halls”
    3. Issac Nealey: “The effects of neighborhood views containing multiple environmental features on road traffic noise perception at dwellings”
    4. Christopher Loree: “Monaural Detection of Phase Difference Between Clicks”
    5. Raphael (Raki) Dawis: “The CIPIC HRTF Database”

• Week 6:
- **Timbre**

- **2 student presentations** Perception (Tuesday, 20 mins)
  1. Alex Chuk: “Timbre Space as a Musical Control Structure”
  2. Meghan Kennedy: “More than Just Notes: Psychoacoustics and Composition”

- **Exam 2**: Thursday, first 45 mins.
  - *Timbre*: average spectral shape, formants, missing harmonics, time variation, tuning with stretched partials.

- **Reading**: Cook chapter 7.

- **3 student presentations** Perception (Thursday, 40 mins):
  2. Kostyantyn Chumakov: “Auditory Illusions and Confusions”
  3. Cordane Richardson: “Hearing Lips and Seeing Voices”

- **Week 7**:

  - **Ambiguity in Music**
    - *Auditory Streaming*: ambiguity, common fate, separation with apparent motion, Shepard tones, tritone paradox
  - **Reading**: Cook chapter 10.

- **Week 8**:

  - **Pitch**
    - *Pitch Perception*: place theory of pitch, repetition pitch, pitch paradox, jnd, mel scale
  - **Reading**: Cook, chapter 5

- **Week 9**:

  - **Pitch cont.**
    - *Pitch 2*: jnd, mels scale, pitch spaces
    - Consonance: scales, periodicity, intervals, beating, Rameau and inversions, pitch errors in scales, cents
  - **Reading**: Cook chapter 13 and 14
  - **Thursday: 6 student presentations** Pitch Perception (Thursday, first 60 mins):
    1. Francis Galang: “Beat Theories of Musical Consonance” (may be moved to week 9)
2. Cory Banh: “Interval-Class Content in Equally Tempered Pitch-Class Sets: Common Scales Exhibit Optimum Tonal Consonance”
3. Amir Moheimani: “Octave Generalization and Tune Recognition”
4. Kenroe Ang: “Local Consonance and the Relationship Between Timbre and Scale”
5. Timothy Wang: “Attaining Consonance in Arbitrary Scales”

• Week 10:
  – Tuesday: 6 student presentations Pitch Perception (cont.) and Bioacoustics/Animal Perception
    1. Nancy Xu: “Theoretical and Experimental Exploration of the BohlenPierce Scale”
    2. Mugdha Joshi: “Bat echolocation calls facilitate social communication”
    3. Kelli Rice: “Squeezing speech into the deaf ear”
    6. Gavin Badillo: “Extremely high frequency sensitivity in a ‘simple’ ear”
  – Thursday: Exam 3:

Assignments

Assignment are to be submitted on TED by 12:15PM (before class) on the day they are due.

• Week 1:
  – Due Tuesday April 11.
    – Download Pd and create a sine wave for which you can change the frequency.
    – Reading: Cook, chapter 4.

• Week 2:
    – Download harmonicity.pd and answer the following questions.
      1. Play a square and then triangle wave. Describe (qualitatively) the difference you hear between the tones. The difference is the timbre (pronounce TAM-BRRR).
2. For BOTH square and triangle waves, change the frequency of the 3rd harmonic until you no longer perceive the sound as having a clearly defined pitch (you can do this while the note plays continuously or by turning it on and off). Note the change in frequency. Is it different for each of the waveforms?

3. Reset the frequencies and select a SQUARE wave. Change the 7th harmonic until you no longer perceive a pitch. Note the change in frequency. Is it the same, more, or less than for the 3rd harmonic for the square wave in the previous step?

4. Reset frequencies and change the amplitude of the 5th harmonic until you hear a change in the timbre (tone quality of the sound). Note the amplitude (in terms of the quotient number).

5. Lower the amplitude of the fundamental by raising the quotient number until increasing no longer makes a difference in the perceived sound. Do you still hear the same pitch?

– Reading: Cook, chapter 1 and 6.

• Week 3:

– Due April 27, 2017

– Download twoVoicesLocation.pd, message1.wav, message2.wav

  * Play example 1 and try to transcribe the text of the two spoken messages.
  * Play example 2 and see if it’s easier to transcribe, correcting your transcriptions where necessary.
  * Submit your final transcriptions of both texts

– Download FrequencyAndLoudness.pd. Test how your hearing compares to 2 of Fletcher-Munson’s equal loudness curves, one at 20 phons and one at 60 phons, by setting a reference tone to 80 Hz and a second tone to 2000 Hz.

  * Determine from the curves at what level an 80-Hz reference tone should be when testing the 20 phon curve.
  * Write this value down (as part of your submission) and use the value to set the level of the reference tone in the patch.
  * **Without looking at the curve**, at what level did you set the 2000 Hz tone so that it sounded equally loud?
  * Now **looking at the curve**, at what level does the curve suggest it should have been?
  * Repeat for the 60 phon curve, answering the same questions.

– If you haven’t already done so, choose a paper (from section **Short Presentation** below) and sign up for a 8-10 minute presentation. Email your selection directly to me (trsmyth@ucsd.edu) with subject **Music 175 Short Paper Selection**.

– Reading: Cook, chapter 8.
• Week 4:
  – Reading: Cook, chapter 3.

• Week 5:
  – Due date TBA.
  – Reading: Cook, chapter 7.

• Week 6:
  – Due Tuesday May 9, 2017
  – Final project proposal: write a 1-2 paragraph proposal describing your project and submit on TritonEd. Once you get approval you may begin working on your project!

Short Presentation

• Choose a paper from references below and prepare a 10-minute paper presentation. Sign up for a time slot by the end of week 3.

• Hearing in Time and Space
  


• Pitch

**Timbre/Perception**


**Pitch/Consonance/Scales**


**Timbre**


**Speech Perception**


**Animal Hearing/Perception**

- Bat echolocation calls facilitate social communication”, available [here](#).

**Student Choices (added Spring 2016-2017)**


**Project**

The project may consist of:

- “pure” research
- pd listening experiment + paper
- music analysis/create (yours or another) illustration of an auditory effect + paper
- other
Final project presentation

• Presentations will be during the final exam period.
• Papers should be constrained to 5-10 pages.
• The paper’s grade will be based on both its style, i.e. that it consistently follows a standard research style (e.g. MLA, APA, Chicago, etc), and its content, i.e. it is well written and clear, the information is correct and accurate etc.
• Proposals: Each student must submit a list of 2 proposed topics, each with a brief description (and possibly a drawing if appropriate), ranked in order of preference.

Exams

Exams will be based on lectures, assigned readings, and student presentations.