Music 175: Psychoacoustics  
Spring 2016

Tamara Smyth, trsmyth@ucsd.edu  
Department of Music,  
University of California, San Diego (UCSD)  
April 28, 2016

Course Information

Teaching Assistant
- Jennifer Hsu jsh008@ucsd.edu

Meeting Time and Place

Meeting Dates: 2016/3/29 - 2016/6/2

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture: TuTh 12:30PM -1:50PM</td>
<td>CPMC 367</td>
<td>Smyth</td>
</tr>
<tr>
<td>Office hours: Tu 11:30-12:30PM (before class)</td>
<td>CPMC 233 (office)</td>
<td>Smyth</td>
</tr>
<tr>
<td>Office hours: Tu 2:00-3:00PM (after class)</td>
<td>CPMC 265</td>
<td>Hsu</td>
</tr>
<tr>
<td>Final Exam (projects): M 11:30AM-2:30PM (2016/6/6)</td>
<td>CPMC 367</td>
<td>NA</td>
</tr>
</tbody>
</table>

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 21, 2016: Exam 1.

• Thursday, May 12, 2015: Exam 2.

• Thursday, June 2, 2015: Exam 3 (last day of class).

• Monday June 6, 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.
  – 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
    * **Time and Space**: “cocktail party”, binaural masking, precedence effect, re-verberation, localization.
  – **Reading**: Cook, Chapter 8.

• Week 4:
  – **Exam 1** (Thursday, first 45 mins of class)

• 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
  – **4 student presentations** Hearing in Time and Space (Thursday, first 50 mins):
    1. Kevin Di Bella: “Comparative Study of European Concert Halls”
    2. Steven Lee: “A General Model for Saptial Processing of Sounds”
    4. Jordan Field: “Monaural Detection of Phase Difference Between Clicks”

• Week 6:
  – **Timbre**
    * **Timbre**: average spectral shape, formants, missing harmonics, time variation, tuning with stretched partials.
  – **Reading**: Cook chapter 7.
  – **5 student presentations** Perception (Thursday, first 60 mins):
    1. Kevin Mach: “Timbre Space as a Musical Control Structure”
2. Ben Martin: “Multidimensional Perceptual Scaling of Musical Timbres”
3. Haley Oosterhouse: “Auditory Illusions and Confusions”
5. Adrian Santoso: “Control Methods Used in a Study of the Vowels”
6. Alex Arango: “More than Just Notes: Psychoacoustics and Composition”

• Week 7:
  - **Ambiguity in Music**
    - **Auditory Streaming**: ambiguity, common fate, separation with apparent motion, Shepard tones, tritone paradox
  - **Reading**: Cook chapter 10.
  - **Exam 2**: Thursday, first 45 mins.

• Week 8:
  - **Pitch**
    - **Pitch Perception**: place theory of pitch, repetition pitch, pitch paradox, jnd, mel scale
  - **Reading**: Cook, chapter 5

  - **4 student presentations** Pitch Perception (Thursday, first 50 mins):
    1. TJ Bellings: “Octave Generalization and Tune Recognition”
    2. Ryan Yamane: “Attaining Consonance in Arbitrary Scales”
    4. Bradley Stevenson: “Interval-Class Content in Equally Tempered Pitch-Class Sets”
    5. Adam Kim: “Circularity in Judgments of Relative Pitch”

• 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

  - **4 student presentations** Pitch Perception (cont.) and Bioacoustics/Animal Perception (first 50 mins)
1. Trevor Sauerbrey: “Beat Theories of Musical Consonance”
3. Junseok Shim: “Squeezing speech into the deaf ear”
4. Kendra Quinlan: “Bat echolocation calls facilitate social communication”
5. Todd Everett: “Extremely high frequency sensitivity in a ‘simple’ ear”

- **Week 10:**
  - **Exam 3:** Thursday, first 45 mins.

**Assignments**

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

- **Week 1:**
  - Download [Pd](#) and create a sine wave for which you can change the frequency (DUE: Tuesday April 5).
  - Reading: Cook, chapter 4.

- **Week 2:**
  - Download [harmonicity.pd](#) and answer the following questions (DUE: Thursday April 16):
    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:
  - 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:
  - Reading: Cook, chapter 7.
  - Final project proposal: write a 1-2 paragraph proposal describing your project and submit on TritonEd by Thursday May 5. 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**
  - (Hearing in moths) Hannah M. Moir, Joseph C. Jackson and James F. C. Windmill. “Extremely high frequency sensitivity in a 'simple' ear”, available [here](#).
  - Mirjam Kunschild et al. “Bat echolocation calls facilitate social communication”, available [here](#).

- **Student Choices (Spring 2016)**
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 3 proposed topics, each with a brief description (and possibly a drawing if appropriate), ranked in order of preference. Due Thursday, May XX, 2015.

Exams

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