Music 175: Psychoacoustics  
Spring 2019  

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University of California, San Diego (UCSD)  
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Course Information

Teaching Assistant

- Nicholes Solem nsolem@ucsd.edu

Meeting Time and Place

Meeting Dates: 2017/4/2 - 2017/6/6

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Location</th>
<th>Instructor</th>
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</thead>
<tbody>
<tr>
<td>Lecture:</td>
<td>TuTh 12:30PM -1:50PM</td>
<td>CPMC 367</td>
<td>Smyth</td>
</tr>
<tr>
<td>Office hours:</td>
<td>Th 11:00-12:00PM (before class)</td>
<td>CPMC 243</td>
<td>Solem</td>
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<tr>
<td>Office hours:</td>
<td>Th 2:00-300PM (or by appointment)</td>
<td>CPMC 233</td>
<td>Smyth</td>
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<tr>
<td>Final project/paper presentations</td>
<td>M 11:30AM-2:30PM (6/11/2018)</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 tests (15% each): 45%
- 1 assigned paper presentation: 15%
- occasional assignments/experiments: 15%
- Final project/paper and presentation 20%
- participation (attendance) 5%

Required Textbooks

- Perry R Cook (editor). Music, Cognition, and Computerized Sound: An Introduction to Psychoacoustics (available [here](#)).
- Brian Moore. An Introduction to the Psychology of Hearing (available [here](#)).
- Music 175 on-line notes.

Important Dates

- Thursday, April 25, 2019: Test 1.
- Thursday, May 16, 2019: Test 2.
- Thursday, June 6, 2019: Test 3.
- Monday June 10, 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
    * **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: Audio Spatialization Lab (Spat Lab), Calit2 (April 23, 2019)
    - **Exam 1**: April 25, 2019 (Thursday, last 45 mins of class)
    - **Student paper presentation(s)** Hearing in Time and Space (Thursday)

- Week 5:
  - **Student paper presentation(s)** Hearing in Time and Space (Tuesday)
    * Mason Davis: “Comparative Study of European Concert Halls”.
    * Erick Garcia: “Synchronization in Performed Ensemble Music”.
    * Andrew Luong: “The CIPIC HRTF Database.”
  - 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

- Week 6:
- **Timbre**
  - *Timbre* average spectral shape, formants, missing harmonics, time variation.
- **Reading**: Cook chapter 7.
- **Student paper presentations** Timbre

- **Week 7:**
  - **Ambiguity in Music**
    - *Auditory Streaming* ambiguity, common fate, separation with apparent motion, Shepard tones, tritone paradox
  - **Exam 2: May 16, 2019** (Thursday, first 45 minutes)
  - **Reading**: Cook chapter 10.
  - **Student paper presentations** Illusion
    - * Devin Luu: “Auditory Illusions and Confusions”

- **Week 8:**
  - **Pitch**
    - *Pitch Perception* place theory of pitch, repetition pitch, pitch paradox, jnd, mel scale
  - **Reading**: Cook, chapter 5
  - **Student paper presentations** Pitch Perception
    - * Hugh Shin: “Octave Generalization and Tune Recognition”.

- **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
  - **Student paper presentations** Pitch Perception

- **Week 10:**
  - **Student paper presentations** Bioacoustics/ Animal Perception
Martine: “Bat echolocation calls facilitate social communication”.

Jason Gray: “Extremely high frequency sensitivity in a ’simple’ ear” (Hearing in moths).


– Exam 3: June 6 2019 (Thursday, last day of class, first 45 minutes)

Assignments

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

• Week 1:
  – Due Tuesday April 9, 2019.
  – Download Pd and create a sine wave for which you can change the frequency.
  – Reading: Cook, chapter 4.

• Week 2:
  – Due Tuesday April 16, 2019.
  – 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 23, 2019
– Download [twoVoicesLocation.pdf, 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.pdf]. 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.
  * Week 6:
    – 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

Papers Available for Selection:
(Selected papers appear in a separate list below.)

- 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. (Papers already selected appear in a separate list at the bottom.)

- **Hearing in Time and Space**

- **Pitch**

- **Timbre/Perception**

- **Pitch/Consonance/Scales**


Timbre


Speech Perception


Animal Hearing/Perception

Student Choices (added Spring 2016-2018)


Selected Papers:


2. Mirjam Kurnschild et all. “Bat echolocation calls facilitate social communication”, available [here](#).

3. (Hearing in moths) Hannah M. Moir, Joseph C. Jackson and James F. C. Windmill. “Extremely high frequency sensitivity in a ‘simple’ ear”, available [here](#).


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.