

# 21M.380 MUSIC AND TECHNOLOGY SOUND DESIGN

## LECTURE No7 PERCEPTION OF SOUND

WEDNESDAY, FEBRUARY 24, 2016

### 1 Perception of sound

#### 1.1 Perception of harmonic spectra

Demo with Baudline (<http://baudline.com/>)

- Amplitude relates to loudness
- Fundamental frequency relates to pitch
- Spectrum relates to timbre

#### 1.2 Human auditory system

- Outer ear (pinna, auditory canal, ear drum)
- Middle ear (3 ossicles act as impedance transformer)
- Inner ear (filled with fluid, cochlea contains basilar membrane with haircells connected to auditory nerve)

#### 1.3 Sound localization

- Accurate sound localisation is supported by (Farnell 2010, sec. 6.1):
  - High-frequency sounds with sharp attacks
  - Free space without reflections
  - Ability of listener to move head
- Two important cues (complement each other over audible frequency range):
  - Interaural time differences (ITD)
  - Interaural intensity (or level) differences (IID)
  - Exercise: What's the maximum ITD we'd expect?

#### 1.4 Loudness perception

- Equal loudness contours

## 1.5 Pitch perception

- Rhythm-pitch continuum (as the frequency of a pulse train increases)
- Phantom fundamental:
  - The pitch of a harmonic spectrum is perceived at its fundamental frequency even if that frequency itself is absent.
  - Exercise: Writing a Pd patch to illustrate this phenomenon

## 1.6 Perception of short attacks

- “Attack times of less than 10 ms are generally heard as a click.” (Farnell 2010, p. 89)
- Let’s verify this in Pd

## 2 Preview: Soundwalk

- Westerkamp (2007) reading was due today
- If you haven’t read it yet, please do so before Tue
- For next class meeting, please bring coats (and little else)!

## References and further reading

- Farnell, Andy (2010). *Designing Sound*. Cambridge, MA and London: MIT Press. 688 pp. ISBN: 978-0-262-01441-0. MIT LIBRARY: 001782567. Hardcopy and electronic resource.
- Westerkamp, Hildegard (2007). “Soundwalking.” In: *Autumn Leaves. Sound and the Environment in Artistic Practice*. Ed. by Angus Carlyle. Paris: Double Entendre, pp. 49–54. ISBN: 978-0-9548074-3-6. MIT LIBRARY: 002198647. Available in a slightly different version at <http://cec.concordia.ca/econtact/Soundwalk/Soundwalking.html>.

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