

Sound Studies and Sonic Arts

Winter Term 2022/23

Phase Basic

Module Basic Audio Technology

Course Title Basic Audio Technology

Course Times and Location Wednesdays 10:15 – 11:45 | LIE 314

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Office Hours and Location upon request

Course Description

The course is based on material by Johannes Regnier and is held by Kassian Troyer.

The course aims to give students in Sound Studies and Sonic Arts a solid introduction to acoustics and audio technology as it appears in artistic and musical practices, both in theory and practice.

The lecture gives introduction to essential technologies and tools used to capture, create, manipulate and reproduce sound: microphones, loudspeaker, computers. Techniques and theoretical concepts will be illustrated within REAPER (<http://reaper.fm/>) and through practical programming within the MAX software environment (<https://cycling74.com/>) (alternatively it also possible to use Pure Data instead. It is free and available here: <http://msp.ucsd.edu/software.html>)

Prerequisites: no prerequisites, besides willingness to learn. This course is aimed primarily at students with little to no experience with audio technology. More experienced students who would like to refresh their knowledge are welcome of course.

The workshop “Hands on Sound” by Lukas Grundmann directly relates to this lecture and will enable you to practically apply the techniques discussed.

Schedule

26 Oct Fundamentals of Sound and Musical acoustics 1: What is sound

- Properties of a Waveform (wavelength, period, frequency)
- SPL and dB

2 Nov Fundamentals of Sound and Musical acoustics 2

- Fundamental Signals: Sinusoids and Noise.
- Properties of a Sinusoid (frequency, phase, initial phase)
- Fundamental Operations on an Audio Signal: Amplification, Delay, Mixing
- Beating and Interference

9 Nov Spectra

- Frequency Domain
- Harmonic vs. Inharmonic Spectrum
- Classic Periodic Waveforms
- Pitch vs. Frequency

16 Nov Fundamentals of Digital Audio

- Continuous Time vs. Discrete Time, Analog to Digital Conversion
- Sample Rate, Nyquist Theorem, Aliasing

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- Quantization and Bit Depth, Reconstruction

23 Nov Recording and playback technology 1

- Microphones: Types of Transducers, Polar Patterns
- Basics of Microphone Techniques, Stereo Miking

30 Nov Recording and playback technology 2

- Loudspeakers: Loudspeakers Components, Types of Transducers, Types of Loudspeaker Systems

7 Dec Recording and playback technology 3

- Signal Flow, Recording Chain
- Digital Audio Recording & Computer

14 Dec Introduction to Digital Sound Synthesis 1

- Oscillators, Filters
- Additive Synthesis, Subtractive Synthesis
- Sample-based Synthesis (Sampling, Wavetables, Granular Synthesis)

4 Jan Introduction to Digital Sound Synthesis 2

- Amplitude Modulation, Ring Modulation
- Frequency Modulation
- (& others, if time allows)

11 Jan Control and Interaction

- Control Signal vs. Audio Signal
- MIDI protocol
- Open Sound Control (OSC)
- Signal as control, sensors (if time allows)

18 Jan Audio Effects 1

- Equalization, Compression
- Distortion, Wave-shaping

25 Jan Audio Effects 2

- Delay Effects
- Reverberation

1 Feb General Recap

- Help for exam preparation
- Time for additional questions

08.02 : Written Exam

Supporting Media

Optional readings, for those who want to delve deeper into the topics seen during the course.

Acoustics:

F. Alton Everest, Ken C. Pohlmann. Master Handbook of Acoustics. 6th Edition, McGraw Hill Education, 2015

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Audio engineering and recording techniques:

Bartlett, Bruce, and Jenny Bartlett. Practical Recording Techniques: The Step-by-Step Approach to Professional Audio Recording. Seventh edition. New York: Routledge, Taylor & Francis Group, 2017. (basics of recording techniques suited for beginners)

Ballou, Glen, ed. Handbook for Sound Engineers. Fifth edition. Burlington, MA: Focal Press, 2015. (comprehensive resource on audio engineering techniques and technologies).

Computer music techniques and sound synthesis:

Puckette, Miller. The Theory and Technique of Electronic Music. Hackensack, NJ: World Scientific Publishing Co, 2007. Available here: <http://msp.ucsd.edu/techniques.htm> (Knowledge of mathematics-complex analysis, trigonometry, calculus- recommended)

Roads, Curtis. The Computer Music Tutorial. Cambridge, Mass: MIT Press, 1996. (a valuable and comprehensive reference on electronic music techniques)

Roads, Curtis. Microsound. 1. pbk. ed. Cambridge, Mass.: MIT Press, 2004. (good reference on granular synthesis)

Farnell, Andy. Designing Sound. Cambridge, Mass: MIT Press, 2010. (digital sound synthesis and procedural audio techniques, with examples on Pure Data).

Audio Signal Processing:

Smith, Julius O. online books, available here: <https://ccrma.stanford.edu/~jos/> (extensive online resource for audio signal processing. Knowledge of mathematics-complex analysis, trigonometry, advanced calculus- recommended).

Zölzer, Udo. DAFX: Digital Audio Effects. 2nd ed. Chichester, West Sussex, England: Wiley, 2011. (good reference for DSP implementations of audio effects)