Chapter 1. Meeting 1, Foundations: Live Electronics

1.1. Announcements

• 21M.380: Music Technology: Live Electronics Performance Practices

• Creative, hands-on exploration of contemporary and historical approaches to live electronics performance and improvisation, including basic analog instrument design, computer synthesis programming, and hardware and software interface design.

1.2. Overview

• Technology and instrument building

• The diversity of live electronics practices

• About this course

1.3. Instrument Building and Music Making

• Since humans have moved beyond the voice, music and technology have been closely linked

• The development of new technologies has nearly always led to new instruments

• The development of new instruments has often been linked to the development of new performance practices, ensembles, and musics

• In some traditions, instrument building is fundamental to music making

• With modern technology, instrument making becomes an aesthetic type interface design

1.4. Utility versus Aesthetics in Interface Design

• What are the criteria for evaluating a musical interfaces?

1.5. The Early Histories of Electronic and Computer Music

• At least four main branches of development in electronic and computer music

• All converge in live-electronics practices
1.6. A. Dedicated Electronic Instruments

• The Telharmonium: 1898-1901
• The Theremin: 1920
• The electric guitar and organ

• Turntables, radios, and related electronics

1.7. B. Analog Tape and Analog Synthesis

• Musicians, composers, and researchers repurpose radio equipment for music making
• Musique concrète
  • Pioneered by Pierre Schaeffer in late 1940s and 1950s
  • Developed techniques of manipulating, cutting, splicing, and transforming recorded sounds into music

• Electronic music
  • Pioneered by Werner Meyer-Eppler, Herbert Eimert, and Karlheinz Stockhausen in the 1950s
  • Developed techniques of combining sine tones and generated signals with filters and other modulation techniques

• Both techniques quickly merge

• Computer synthesis techniques routinely combine sample- and synthesis-based techniques

**1.8. C. The Modular and Portable Synthesizers**

• 1957: RCA Mark II, developed by Belar and Olson, installed

• 1964: Moog, with composer Deutsch, builds first synthesizer prototype

• 1967: Moog releases modular systems I, II, and III
Numerous varieties of commercial and installation synthesizers are built in the 1960s

Modular designs and interfaces provide a lasting legacy in all synthesis systems

1.9. D. Synthesis on Mainframes and Computers

- Early computers in the 1950s are used for synthesizing sound directly with integrated loudspeakers
- 1957: Max Mathews creates Music I on an IBM 704
• Mathews develops Music II to V, Music N languages develop into to Csound

• Max/MSP and Pd software lineages begin in 1980s

• Other languages and processing frameworks continue to be developed: Supercollider, Impromptu, others

1.10. Live Electronics

• Deployment of these four traditions in performance contexts

• Long tradition of composers and musicians building custom instruments and interfaces

• Long tradition of employing composition and improvisatory practices from jazz and experimental music

• Two basic approaches

• Develop interfaces for controlling computer synthesis and processing

Courtesy of Lawrence Livermore National Laboratory. Used with permission.
• Develop interfaces integrated with electro-mechanical devices and electronics

1.11. A. Interfaces to Computer Synthesis

• The laptop: keyboards, trackpads, mice
• Gamepads: joysticks, wii controllers, related
• Touchscreens: iPhone, iPad, etc
• Custom musical controllers
  • Manta

![Custom musical controller](image_url)

Courtesy of Snyderphonics. Used with permission.

• Lemur
• Analog sensor input via Arduino or other devices
Photo courtesy of SparkFun Electronics.
1.12. B. Interfaces with Integrated Sound Sources

- Turntables
- Custom-built circuits
- Manipulated speakers and other transducers
- Manipulated cassette decks and tape players

1.13. A Personal Performative Context

- For composers of computer music, the move to live-electronics is a major constraint
- Performing with acoustic instruments is a significant musical and technological challenge

Arduino Danger Shield.
Photo courtesy of SparkFun Electronics.
1.14. KIOKU

- Trio of taiko and percussion, alto sax, and live electronics, from 2006 to the present

- Deploy east-asian traditional and folk songs in a free-jazz inspired context

- Led to the development of a comprehensive system employing a number of inexpensive controllers

- Listening: KIOKU: Pinari

1.15. KIOKU Performance System: libOX

- Modular Max/MSP system with a large collection of controllers
• Two dual-analog game pads form the key performance interface

1.16. The Dual Analog Gamepad

• Logitech Dual Action Gamepad
• 2 XY joysticks, 10 buttons, 1 5-position d-pad

• Example: a simple noise instrument
  • Buttons trigger noise sources with different envelopes
  • XY joystick 1: y axis control amplitude, x axis controls high-pass filter
  • XY joystick 2: y axis control amplitude modulation, x axis controls low-pass filter

• An ergonomic, expressive, and inexpensive interface

1.17. 21M.380: Areas of Focus

• Syllabus

• Historical traditions and practices

• Instrument and interface design
  • Pd synthesis tools
• Dual-analog game pads
• Touchscreen controllers with TouchOSC
• Sensors and physical inputs with Arduino
• Elementary electro-magnetic instruments
• Custom-built circuits with basic CMOS ICs
• Composition and improvisation

1.18. 21M.380: Prerequisites
• None but curiosity, willingness to experiment

1.19. 21M.380: Course Meetings
• Two types of meetings
  • Topic meetings: focused on material in readings, listening, and themes, combining lecture, discussion, demonstration, and listening
  • Workshop meetings: improvisation, performance, and discussion
• Bring laptops to all class meetings
• Lecture notes
  • Provided via course website

1.20. 21M.380: Required Course Materials: Software
• Pure Data (Pd), the Pd-extended distribution
  Provides installers for a number of platforms and bundles valuable extension libraries
  http://puredata.info/downloads
• Martingale: a library of Pd resources
1.21. 21M.380: Required Course Materials: Hardware

- Hardware resources up to $100 are required
- A portable powered or battery-powered amplifier for keyboards/synthesizers and the appropriate cable (not a guitar amp). The following are good options, in order of preference:
  1. Phonic MK15 Keyboard Amp ($80) with 3.5mm stereo to RCA male cable (at least 6 feet long)
  2. Behringer Ultratone KT108 15w Keyboard Amplifier ($70 to $75) with 3.5mm stereo to RCA male cable (at least 6 feet long) and two RCA female to 1/4 inch TS (mono) male adapters.
3. Altec Lansing iM-237 Orbit Ultraportable Speaker ($18) or similar (includes attached cable).

4. Numerous alternatives are acceptable: contact me
• A dual-analog game controller

1. Logitech Dual Action USB Gamepad ($10 to $17)

2. There are a few alternatives that may work: contact me

1.22. 21M.380: Assignments: Reading

• All reading assignments are posted on the course website.

• One book:


• Numerous carefully selected articles and chapters:


**1.23. 21M.380: Assignments: Listening**

- All listening assignments will be posted on the course website.
- Take notes when you listen
- What to listen for without notation: duration, instrumentation, method of production, recording or performance context, notable sonic events, form, temporal design and proportions, aesthetic or historical contexts, and/or critical and subjective responses

**1.24. 21M.380: Assignments: Discussion Leaders**

- Students are assigned to cover reading and listening assignments for each class
- Must be available to lead discussion, answer questions, and provide a resource to class
- Must post minimal notes on the class website
- Need two volunteers for next class

**1.25. 21M.380: Assignments: Pd Tutorials**

- Short programming exercises in Pd
- Must be completed before the next class


- Controller/Interface/Instrument Design 1
  - Must use Pd and dual-analog controller
• Must present draft and complete a report
• Due before spring break
• Controller/Interface/Instrument Design 2
  • May use any interface, design, or approach (as long as there are at least two performative input parameters)
  • Must present proposal, draft, and complete a report
• Due at end of semester

1.27. 21M.380: Assignments: Performance Framework
• A design for a composition or performance context
• Completed in small groups
• Will be presented on a concert on 4 May

1.28. 21M.380: Assignments: Submission
• All assignments are submitted digitally via email attachment (or as Forum posts)
• Some assignments are due before class, others are due at 11:59:59 PM on due date
• Late within 1 week: 20% reduction; no assignments accepted after 1 week

1.29. 21M.380: Attendance
• Mandatory and essential
• Always communicate with me about needs for excused absences
• More than one unexcused absence incurs a 3% grade reduction

1.30. 21M.380: Exams and Quizzes
• Quizzes will be announced
• All short written answers
• Quizzes will be based on reading, listening, and course content
• No final exam

1.31. 21M.380: Grading

• Reading and Listening Discussion Leader: 10%
• Pd Tutorials: 10%
• Controller/Interface/Instrument Design 1 Implementation and Report: 15%
• Controller/Interface/Instrument Design 1 Draft: 2.5%
• Controller/Interface/Instrument Design 2 Implementation, Report, and Presentation: 20%
• Controller/Interface/Instrument Design 2 Draft: 2.5%
• Controller/Interface/Instrument Design 2 Proposal: 2.5%
• Performance Framework: 10%
• Performance Frameworks Draft: 2.5%
• Quizzes: 15%
• Participation: 10%

1.32. 21M.380: Additional Policies

• Read entire syllabus
• Common courtesies
• Computers in class
• Academic integrity

1.33. 21M.380: Contact

• Email is always best
• Office hours
1.34. For Next Class

- Download and read entire syllabus
- Download and install Pd and Martingale; test Pd installation
- Purchase/order dual-analog controller and amplifiers
- Bring computers

1.35. Testing Pd Installation

- Download and install Pd-extended
  [http://puredata.info/downloads](http://puredata.info/downloads)
- Launch the Pd application
- Should see the “Pd window”
- Under the “Media” menu, find the “Test Audio and MIDI” option
  Under “TEST TONES,” select 80 (dB), listen for a tone
  If no tone is heard, make sure “compute audio” is selected
• If tone is broken or stutters, configure processing delay

Find “Audio Settings” options under Preferences

Increase delay until test tone is continuous

• If there is no sound, go to Menu: Preferences > Audio Settings
Try to select a different “output device 1”

- Download Martingale
  
  [http://code.google.com/p/martingale](http://code.google.com/p/martingale)

- Place Martingale in a convenient locations (perhaps a directory where you store all Pd scripts)

- Accessing Martingale resources in Pd will be covered in the next meeting

### 1.36. Discussion Leader Assignment Schedule

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21M.380 Music and Technology: Live Electronics Performance Practices
Spring 2011

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