

# **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**

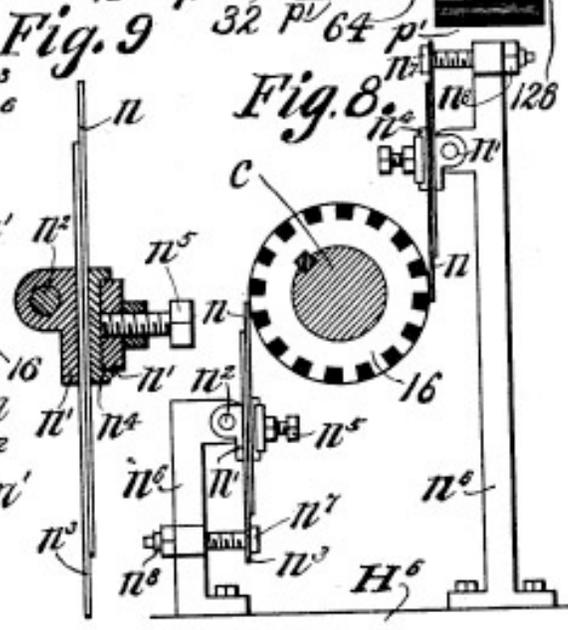
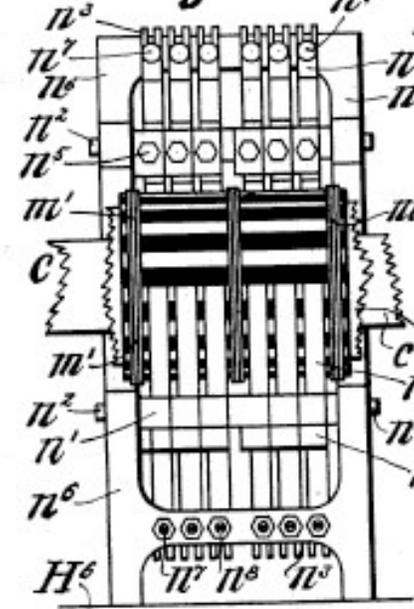
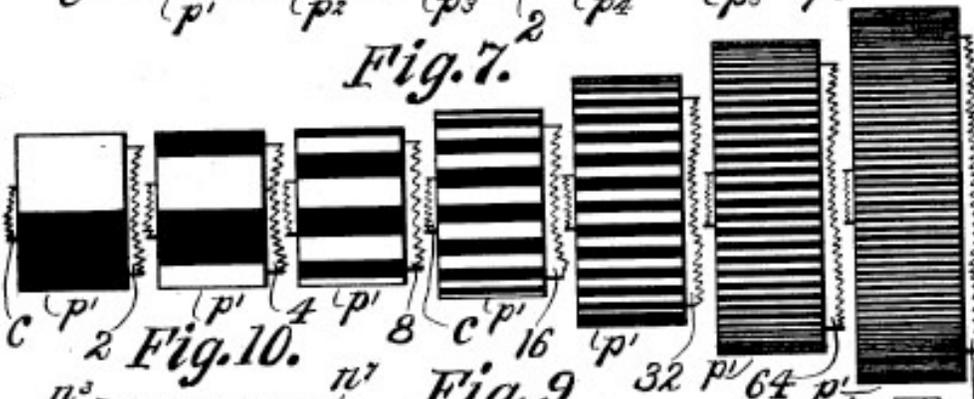
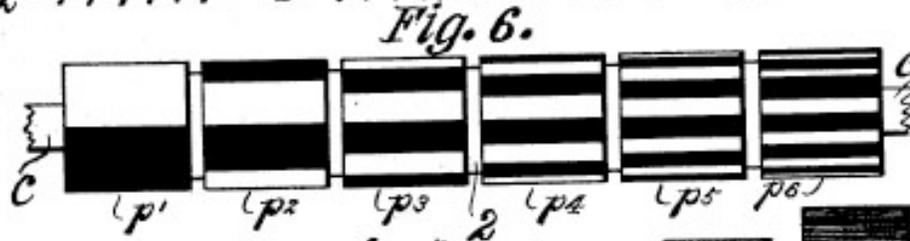
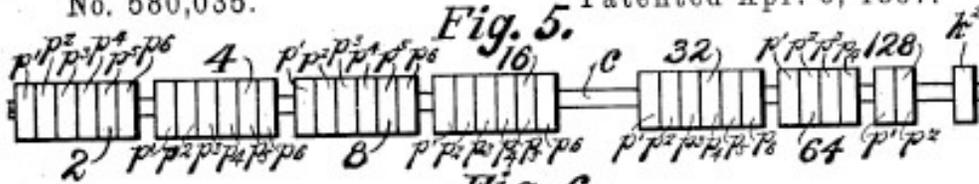
- The Telharmonium: 1898-1901

T. CAHILL.

ART OF AND APPARATUS FOR GENERATING AND DISTRIBUTING MUSIC ELECTRICALLY.

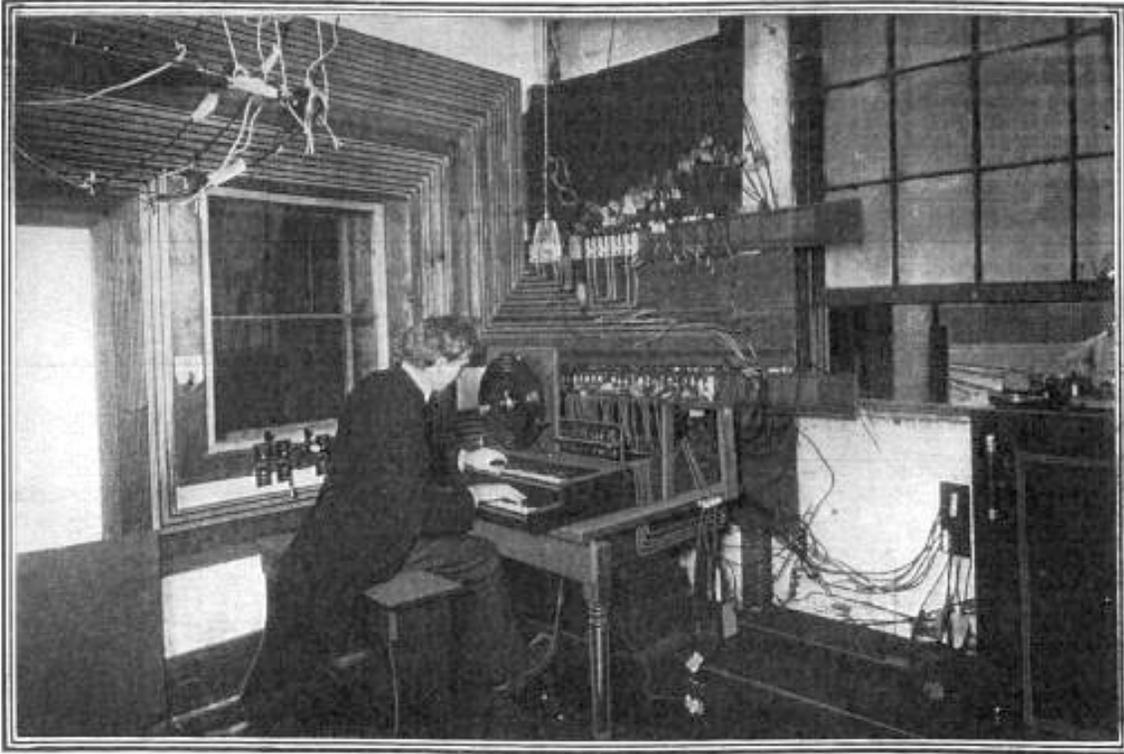
No. 580,035.

Patented Apr. 6, 1897.



Attest.  
 Arthur T. Cahill.  
 M. H. Cahill.

Inventor.  
 Thomas Cahill



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- The Theremin: 1920



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- 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

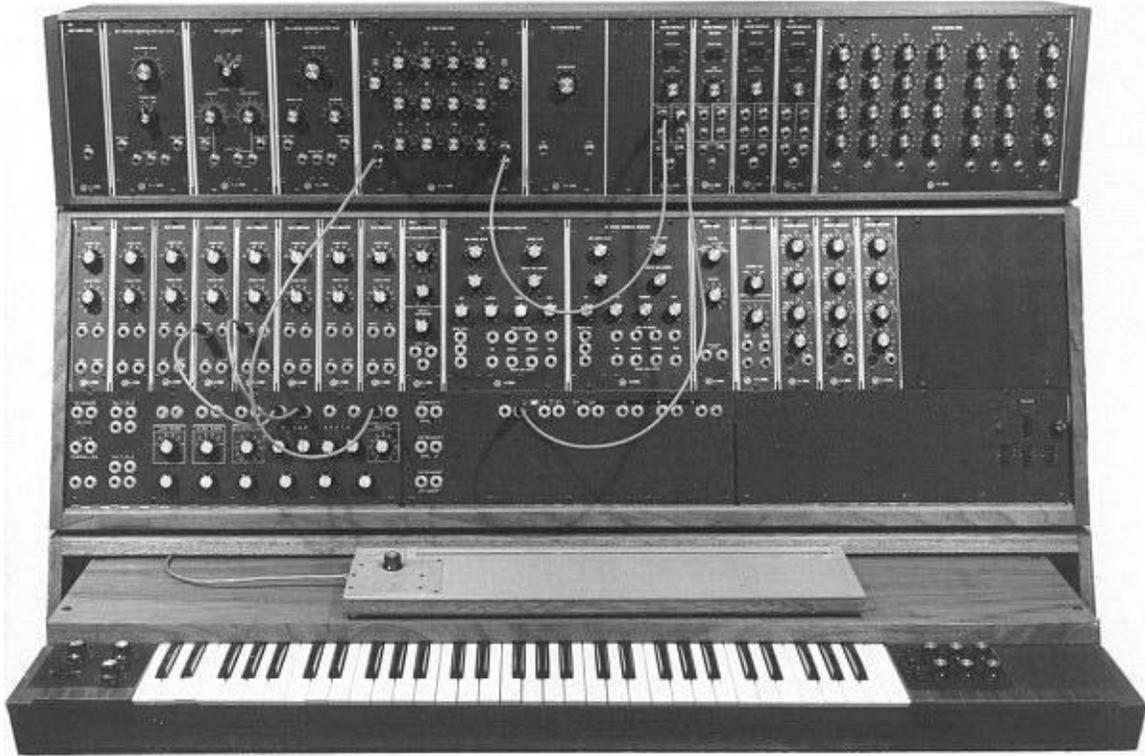
- Musique concrète
  - Pioneered by Pierre Schaeffer in late 1940s and 1950s
  - Developed techniques of manipulating, cutting, splicing, and transforming recorded sounds into music
- Electronic music
  - Pioneered by Werner Meyer-Eppler, Herbert Eimert, and Karlheinz Stockhausen in the 1950s
  - Developed 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



Courtesy of [Roger Luther](#). Used with permission.



Courtesy of [Roger Luther](#). Used with permission.

- 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



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- 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

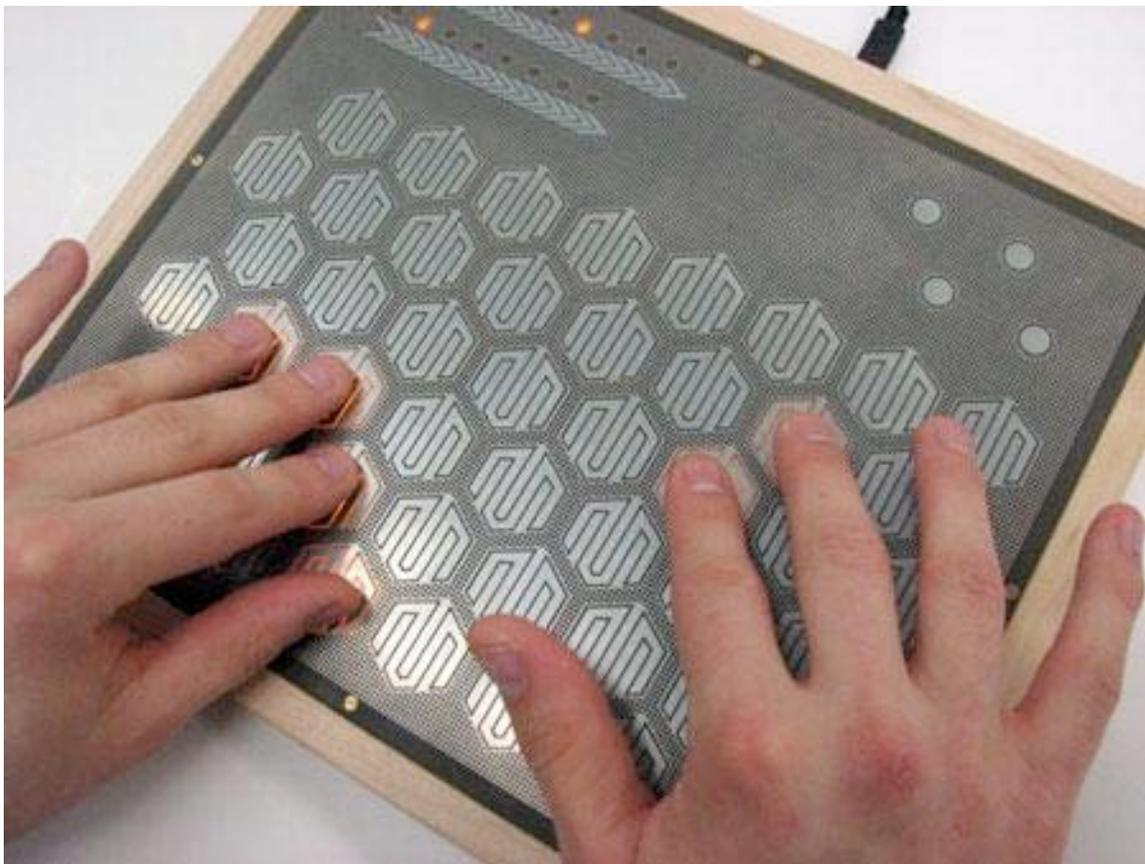
## 1.10. Live Electronics

- 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

- 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



Courtesy of Snyderphonics. Used with permission.

- Lemur



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- Analog sensor input via Arduino or other devices

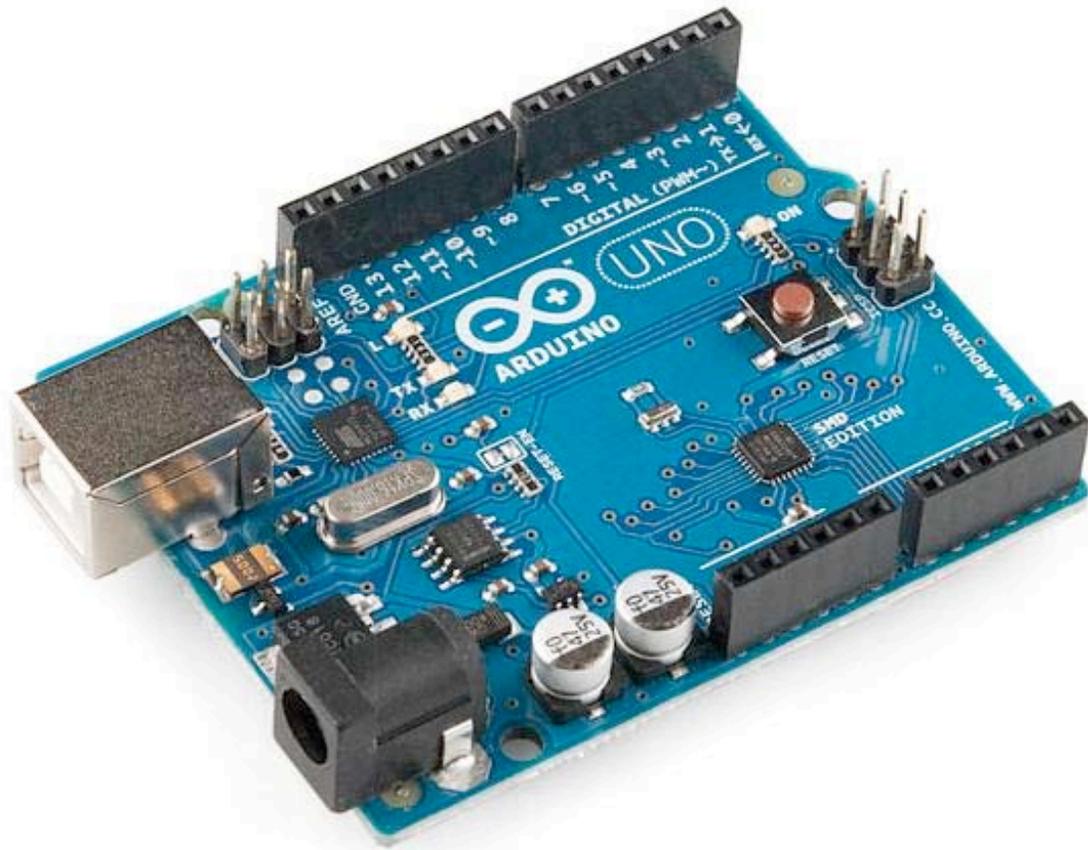
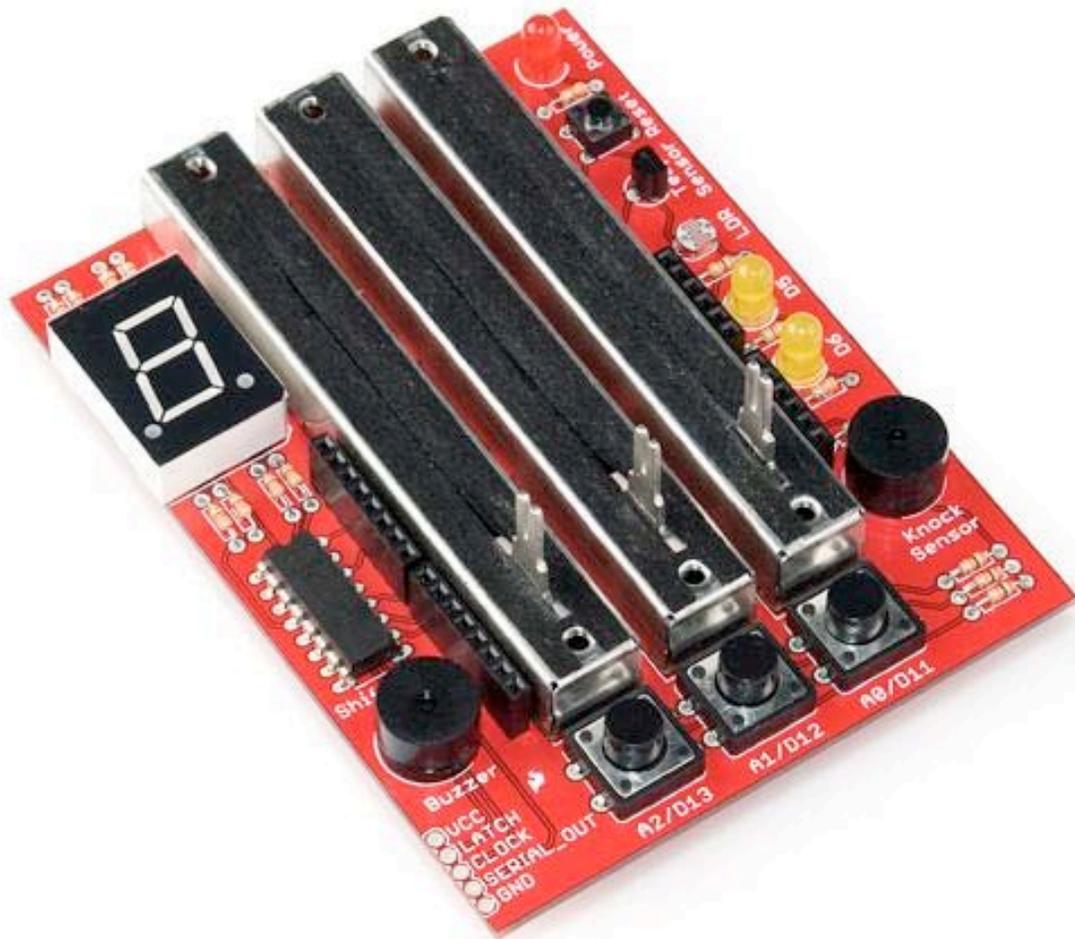


Photo courtesy of SparkFun Electronics.



Arduino Danger Shield.  
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

## 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



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- 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

<http://code.google.com/p/martingale>

## 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)



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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.



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3. Altec Lansing iM-237 Orbit Ultraportable Speaker (\$18) or similar (includes attached cable).



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4. Numerous alternatives are acceptable: contact me

- A dual-analog game controller
  1. Logitech Dual Action USB Gamepad (\$10 to \$17)



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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:

Collins, N. 2009. *Handmade Electronic Music: The Art of Hardware Hacking*. 2nd ed. New York: Routledge.

- Numerous carefully selected articles and chapters:

1. Brown, A. R. and A. Sorensen. 2009. "Interacting with Generative Music through Live Coding." *Contemporary Music Review* 28(1): pp. 17-29.

2. Cascone, K. 2004. "Grain, Sequence, System [three levels of reception in the performance of laptop music]." *Intelligent Agent* 4(1).
3. Collins, N. 2003. "Live Coding in Laptop Performance." *Organised Sound* 8(3): pp. 321-330.
4. Cook, P. 2001. "Principles for designing computer music controllers." *Proceedings of the Conference on New Interfaces for Musical Expression*.
5. Dennis, B. 1991. "Cardew's 'Treatise' (Mainly the Visual Aspects)." *Tempo* 177: pp. 10-16.
6. Driscoll, J. and M. Rogalsky. 2004. "David Tudor's 'Rainforest': An Evolving Exploration of Resonance." *Leonardo Music Journal* 14: pp. 25-30.
7. Fiebrink, R. and G. Wang, P. Cook. 2007. "Don't Forget the Laptop: Using Native Input Capabilities for Expressive Musical Control." *Proceedings of the Conference on New Interfaces for Musical Expression* pp. 164-167.
8. Ghazala, Q. R. 2004. "The Folk Music of Chance Electronics: Circuit-Bending the Modern Coconut." *Leonardo Music Journal* 14(1): pp. 97-104.
9. Gresham-Lancaster, S. 1998. "The Aesthetics and History of the Hub: The Effects of Changing Technology on Network Computer Music." *Leonardo Music Journal* 8: pp. 39-44.
10. Holmes, T. 2008. "Live Electronic Music and Ambient Music." In T. Holmes, ed. *Electronic and Experimental Music*. Third ed. New York: Routledge, pp. 376-406.
11. Kuivila, R. 2004. "Open Sources: Words, Circuits and the Notation-Realization in the Music of David Tudor." *Leonardo Music Journal* 14: pp. 17-23.
12. Perkis, T. 2009. "Some Notes on My Electronic Improvisation Practices." In R. T. Dean, ed. *The Oxford Handbook of Computer Music*. Oxford University Press, pp. 161-166.
13. Puckette, M. 2002. "Max at 17." *Computer Music Journal* 26(4): pp. 31-43.
14. Rebelo, P. and A. Renaud. 2006. "The Frequencyliator—Distributing Structures for Networked Laptop Improvisation." *Proceedings of the Conference on New Interfaces for Musical Expression* pp. 53-56.
15. Ryan, J. 1991. "Some Remarks on Musical Instrument Design at STEIM." *Contemporary Music Review* 6(1): pp. 3-17.
16. Smallwood, S. and D. Trueman, P. R. Cook, G. Wang. 2008. "Composing for Laptop Orchestra." *Computer Music Journal* 32(1): pp. 9-25.
17. Tanaka, A. 2009. "Sensor-Based Musical Instruments and Interactive Music." In R. T. Dean, ed. *The Oxford Handbook of Computer Music*. Oxford University Press, pp. 233-257.
18. Trueman, D. 2007. "Why a Laptop Orchestra?." *Organised Sound* 12(2): pp. 171-179.

19. Wanderley, M. M. and N. Orio. 2002. "Evaluation of Input Devices for Musical Expression: Borrowing Tools from HCI." *Computer Music Journal* 26(3): pp. 62-76.
20. Wang, G. 2007. "A History of Programming and Music." In N. Collins and J. d'Esquiván, eds. *The Cambridge Companion to Electronic Music*. Cambridge: Cambridge University Press, pp. 55-71.
21. Weinberg, G. 2002. "Playpens, Fireflies, and Squeezables: New Musical Instruments for Bridging the Thoughtful and the Joyful." *Leonardo Music Journal* 12: pp. 43-51.
22. Wright, M. 2005. "Open Sound Control: an enabling technology for musical networking." *Organised Sound* 10(3): pp. 193-200.

### **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

### **1.26. 21M.380: Assignments: Controller/Interface/Instrument Design Projects**

- 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

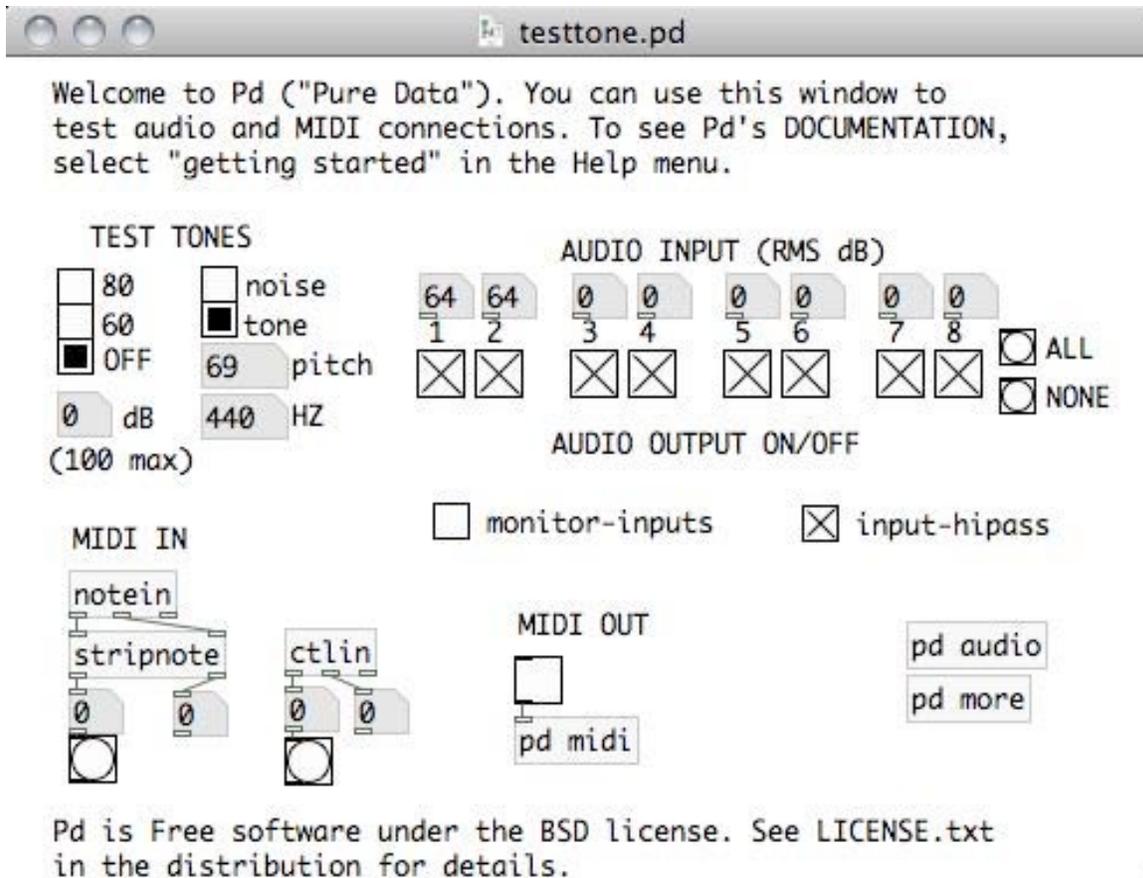
- Download and read entire syllabus
- Download and install Pd and Martingale; test Pd installation
- Purchase/order dual-analog controller and amplifiers
- Bring computers

### 1.35. Testing Pd Installation

- Download and install Pd-extended  
<http://puredata.info/downloads>
- 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

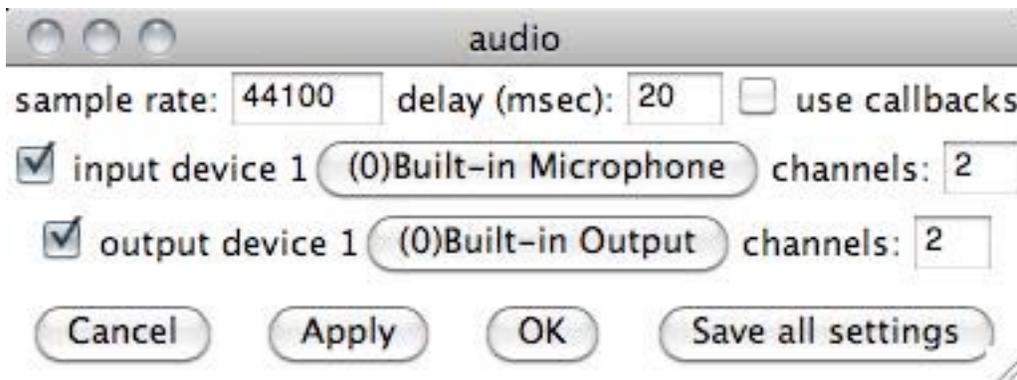
If no tone is heard, make sure “compute audio” is selected



- 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>

- 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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