Chapter 19. Meeting 19, Languages: The History of Notation and MIDI

19.1. Announcements

- Quiz on Thursday
- Music Technology Case Study Final Draft due Tuesday, 24 November

19.2. Listening: Lockwood

- Exclusive use of natural, environmental sounds
- Tape composition, “a musical travelogue of nature sounds that was pieced together as carefully as a dovetail joint to mesh the rhythms of one segment with those of the next” (Holmes 2008, p. 399)
- Interested in using found sounds, did not employ explicit loops or manipulations
- Interested in “acoustic commonalities amongst various disparate sounds” (Holmes 2008, p. 399)
- Originally for 10 channel audio and live mixing and gong
- Listening: Annea Lockwood, *World Rhythms*, 1975

19.3. Listening: Eno

- Trained as a painter and visual artist, influenced by minimalist composers, began musical work on tape recorders
- 1969: Joined Cornelius Cardew’s Scratch Orchestra
- 1971: member of glam band Roxy Music
- First solo album: *Here Come the Warm Jets*
- *Ambient 1: Music for Airports*: divided into four tracks: 1/1, 1/2, 2/1, 2/2

- "Not music from the environment but music for the environment" (Holmes 2008, p. 400)
- Goal of creating environmental music suited for moods and atmospheres; "ambient music must be able to accommodate many levels of listening attention without enforcing one in particular..." (Holmes 2008, p. 401)
- Piano and various synthesized sound are combined in all
- Listening: Brian Eno, "1/2," *Ambient 1: Music for Airports*, 1978

19.4. Languages Used for Music

- Descriptive
    - Western notation
    - Music storage and data languages: MIDI, OSC, MusicXML
- Generative
    - Programming languages for synthesis and sound generation
    - Programming languages for interaction and interface

19.5. Western Notation

- Split sound production from sound instruction
- Motivated by pedagogical needs
- Developed in the European church for vocal music
- Led to a process of increased parameterization
- Led to techniques of creating music
- "... musical notation ... originated first as a mnemonic device for already well-established musical practice, but, like writing, it quickly grew to dominate that musical practice" (Wishart 1996, p. 18)

19.6. Western Notation: Basic features

- Time moves from left to right; spacing is not proportional
- A score consists of one or more parallel staffs; where each staff represents an instrument or part
- Pitch space is represented by notes placed on a vertical grid (the staff); spacing is not proportional
- Rhythm is represented by note shape (solid or empty) and/or flags or beams (with more flags/ beams indicating shorter durations)
- Dynamics (amplitudes) are represented with word abbreviations (e.g. *f* for forte, *p* for piano)
- Listening: Stravinsky: "Le violon du Soldat," Mvmt II from *L'histoire du soldat,* 1918

19.7. The History of Notation: Neumes

- 800s: Earliest neumatic notation

- 900s to 1100s: widespread, diverse practices
- Few musical parameters provided
- Data for parameters provided in general, qualitative values

19.8. The History of Notation: Example Neumes

- 900s to 1000s

Table removed due to copyright restrictions. Neumes of the 10th - 11th centuries, from Grove Music Online.
See Wikipedia: Neume as replacement.

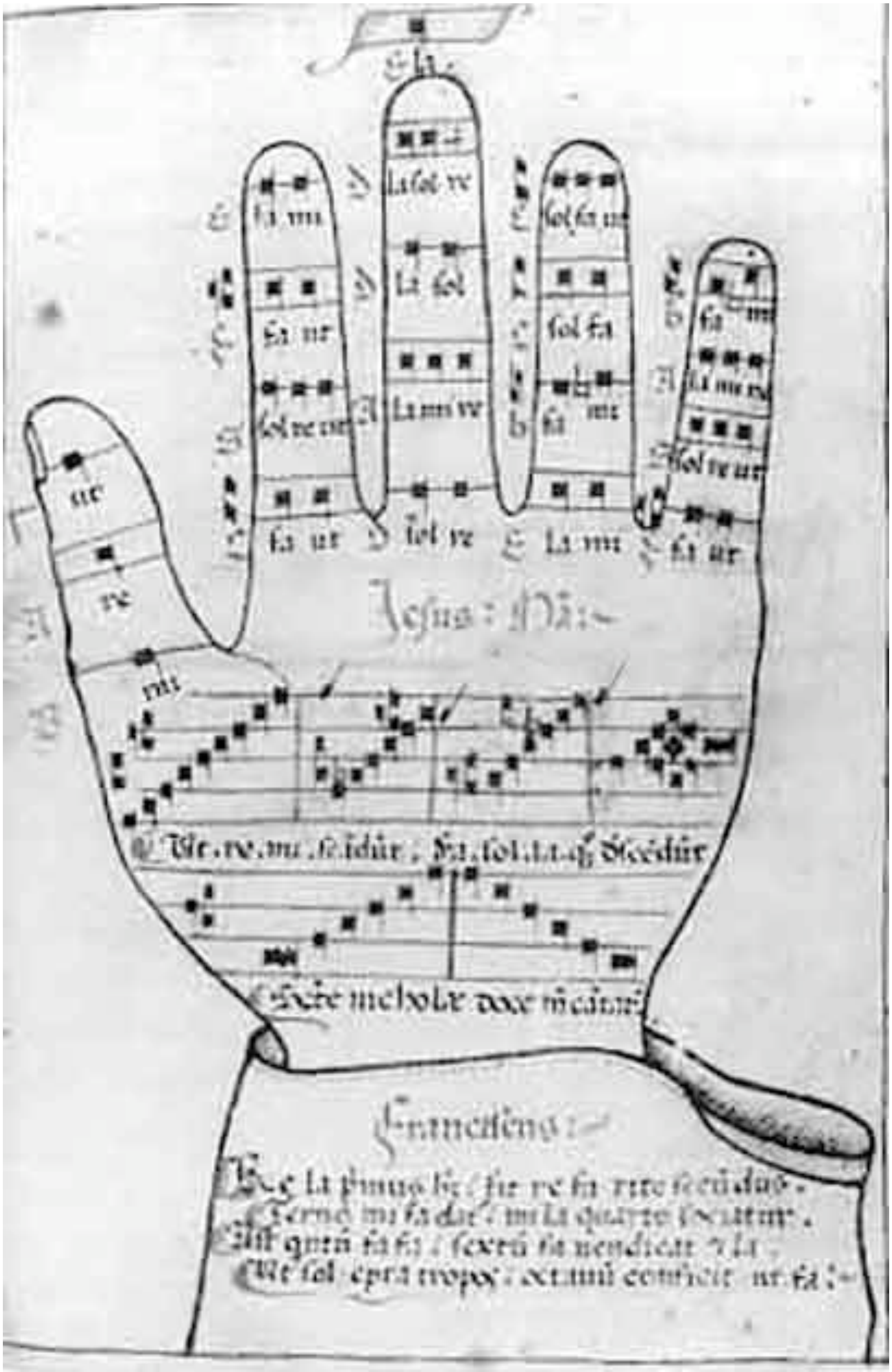
- 1000s to 1100s

Table removed due to copyright restrictions. Neumes of the 11th-12th centuries, from Grove Music Online.
See Wikipedia: Neume as replacement.

19.9. The History of Notation: Discrete Pitch

- Guido of Arezzo: monk, teacher of music to singers
- after 1026: *Micrologus*
- Proposed system of pitch notation with lines and spaces
- Introduced method of sight-singing with ut, re, mi, fa, sol, la

  Introduced mnemonic device to help singers through three octaves of pitches


la sol re
la sol
sol fa ut
sol fa
la mi re
sol re ut
fa ut
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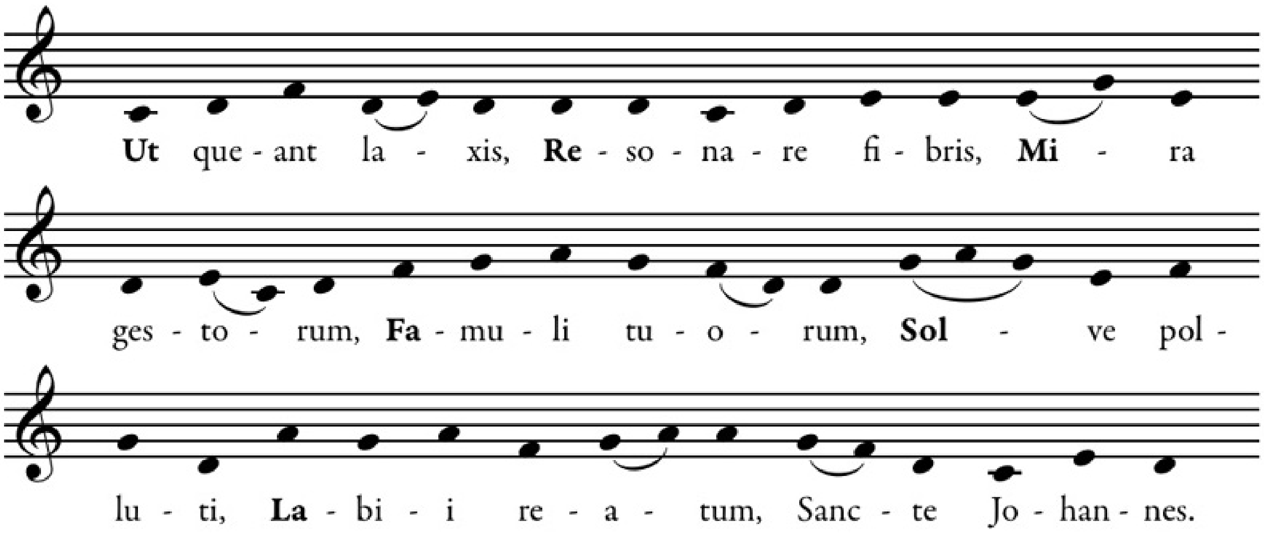

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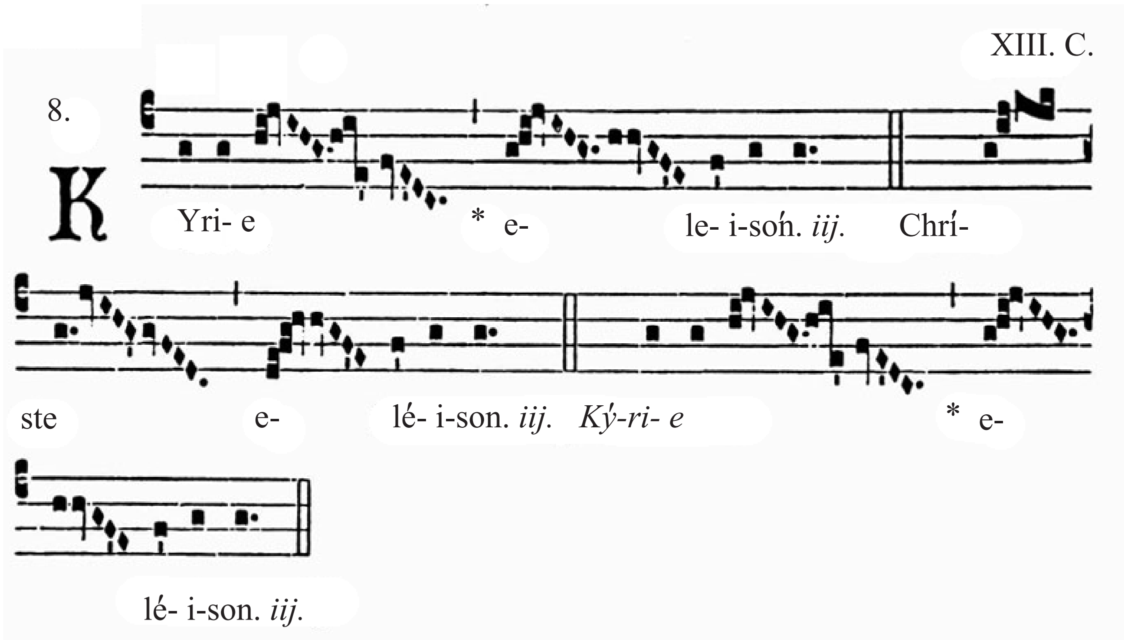
19.10. The History of Notation: Gregorian Chant

- Chant practices of the Catholic church solidified between 1000s to 1200s
- Graduale Aboense, 14th to 15th c hymn book

- *Liber Usualis* (Common Book): issued by monks of Solesmes in 1896

- Kyrie



Listening: Kyrie excerpt

19.11. The History of Notation: Modal Rhythm

- Notated conventional patterns, not discrete rhythms
- Rhythms based on context, closely related to poetic feet (troche, iamb, dactlye, anapest, spondee, pyrrhic)
- 1100s to 1200s

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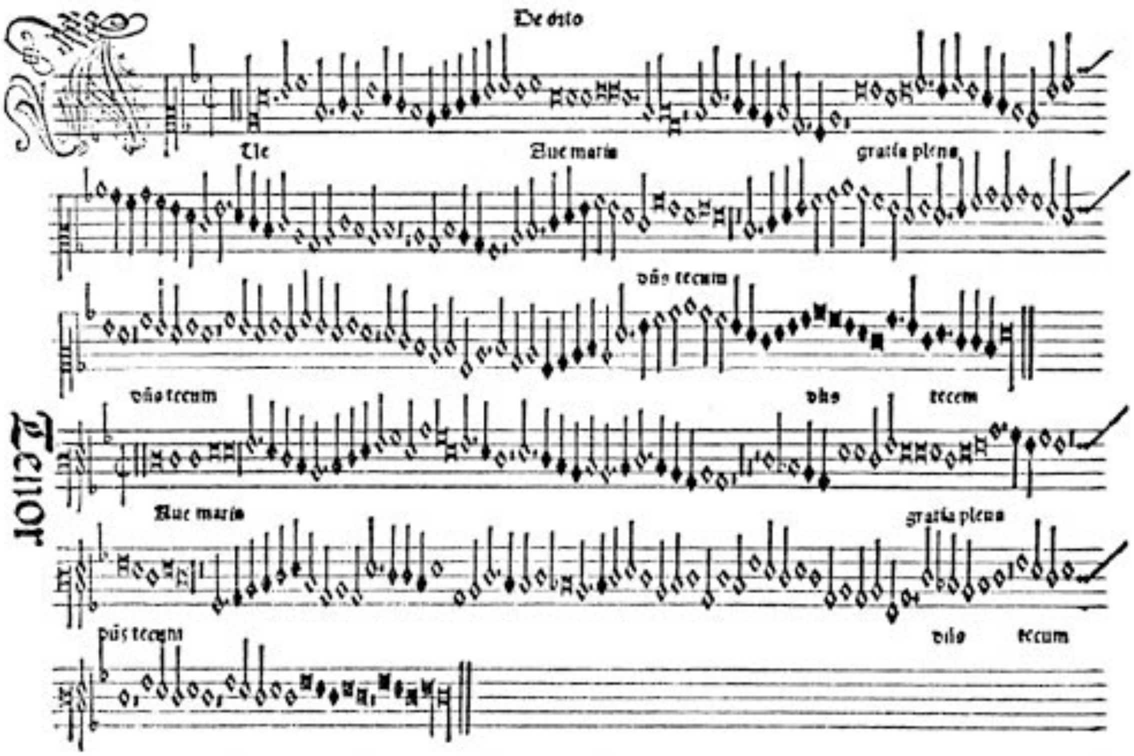
19.12. The History of Notation: Rhythm

- Franco of Cologne: uses shapes to express durations
- Around 1250: *Ars cantus mensurabilis*
- Rhythms based on note appearance

Score removed due to copyright restrictions. From Grove Music Online: comparison of rhythmic notation: modern, white (15th-16th c.), black (14th-15th c.), and Franconian (13th c.).

19.13. The History of Notation: Printing

- 1436: Johannes Gutenberg does first printing with movable type, replace block printing
- Ottavio Petrucci
- 1498: Granted privilege to print music
- 1501: *Harmonice musices odhecaton A*



- First printer to use movable type
- First used three passes: staves, music, and words
- Later used two passes: staves and words, music

19.14. The History of Notation: Dynamics

- Rare before 1600
- 1700s: range of *pp*, *p*, *f*
- Hairpins for crescendi and decrescendi: late 1700s
- 1800s: range of *ppp* to *fff*
- late 1800s: range of *pppppp* to *ffff*

19.15. The History of Notation: Example: Corelli and Bach

- Listening: Corelli (1653-1713): Trio Sonata, Opus 3, Number 2

SONATA II.

Augener's Edition

8442

Arcangelo Corelli, Trio Sonata, Op. 3, No. 2. Source: IMSLP (public domain). From Joachim and Chrysander edition, London, UK: Augener & Co, 1888-1891.

• Listening: J. S. Bach (1685-1750): Goldberg Variation 24

Source: IMSLP (public domain). From C. F. Becker edition, Leipzig: Breitkopf & Härtel (1853).

19.16. The History of Notation: Twentieth Century

- Complex pitches, microtones, bent and altered pitches
- Great detail to articulation and performance techniques
- New symbols required for new instruments and electronics
- New symbolic systems for improvisation, indeterminacy, and new musical contexts

19.17. The History of Notation: Example: Twentieth Century Music

- Listening: Donald Martino (1931-2005): *Notturno*, for flute, clarinet, violin, violoncello, percussion, and piano

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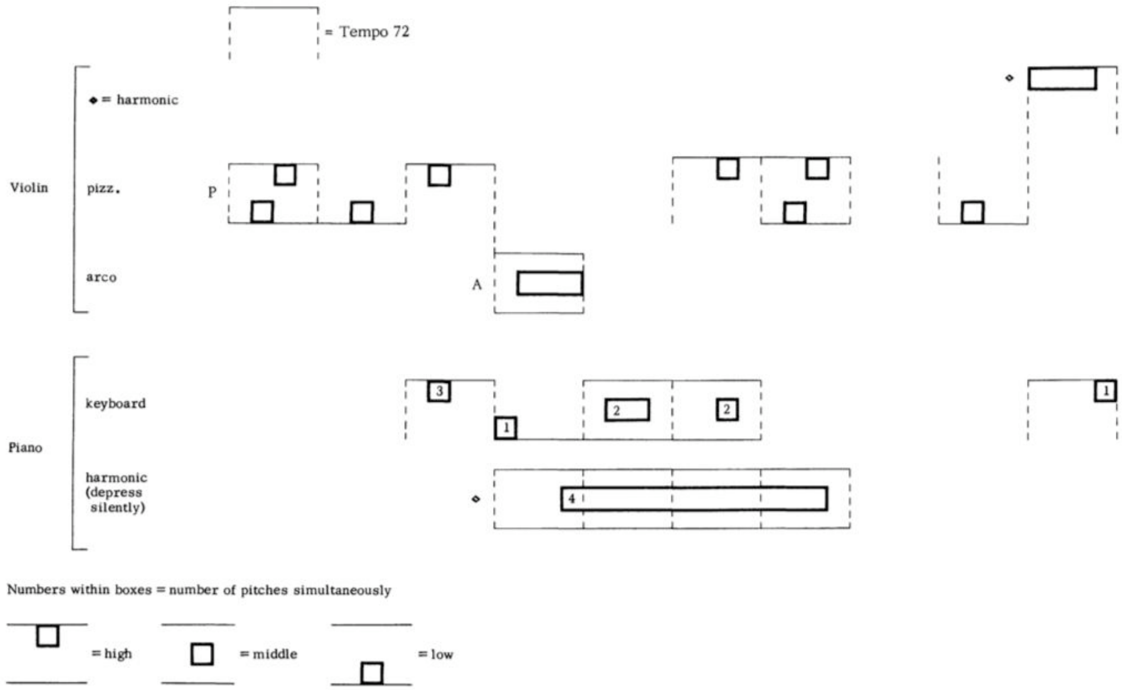
19.18. The History of Notation: Examples: Twentieth Century Music

- While some composers sought more parameters, others looked for alternative parametric representations
- Morton Feldman: *Projection IV* (Behrman 1965, p. 64)



Ex. 4, Feldman, *Projection IV,* first page

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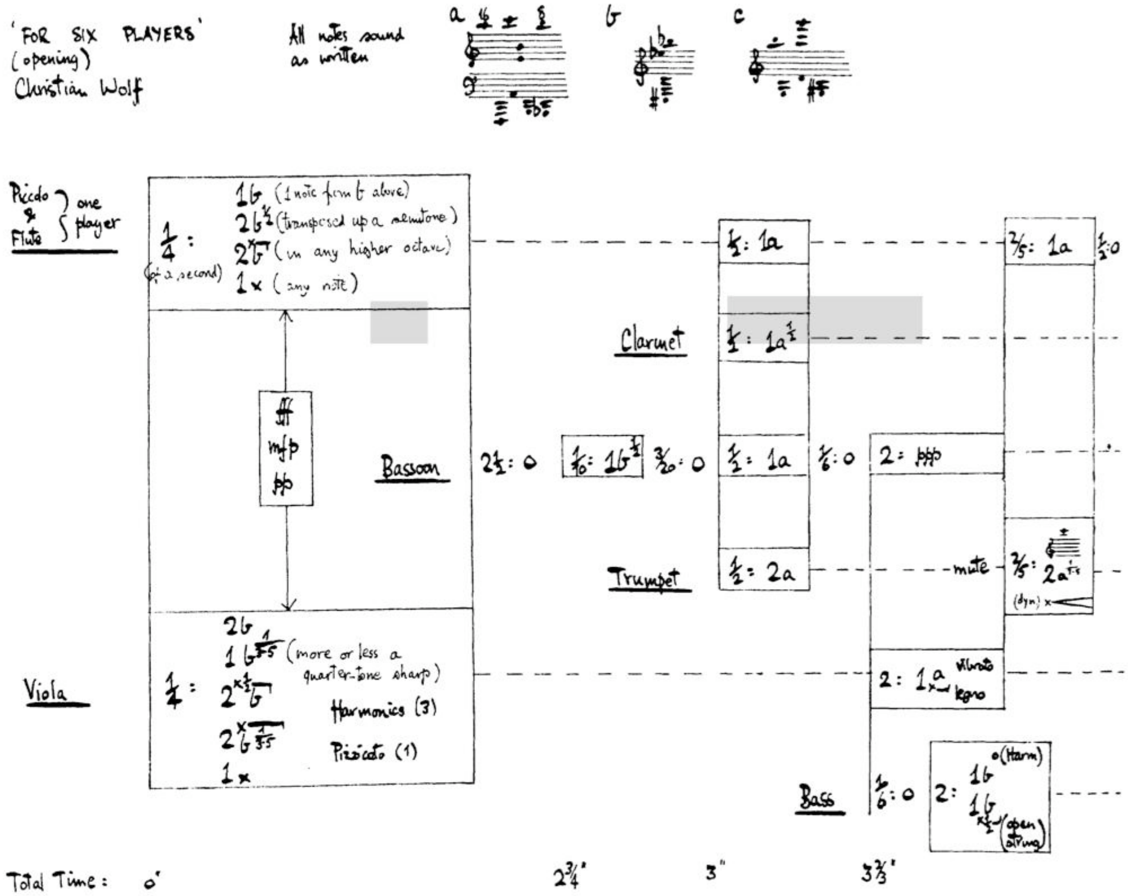
- Christian Wolf: *For Six Players* (Cardew 1961, p. 24)



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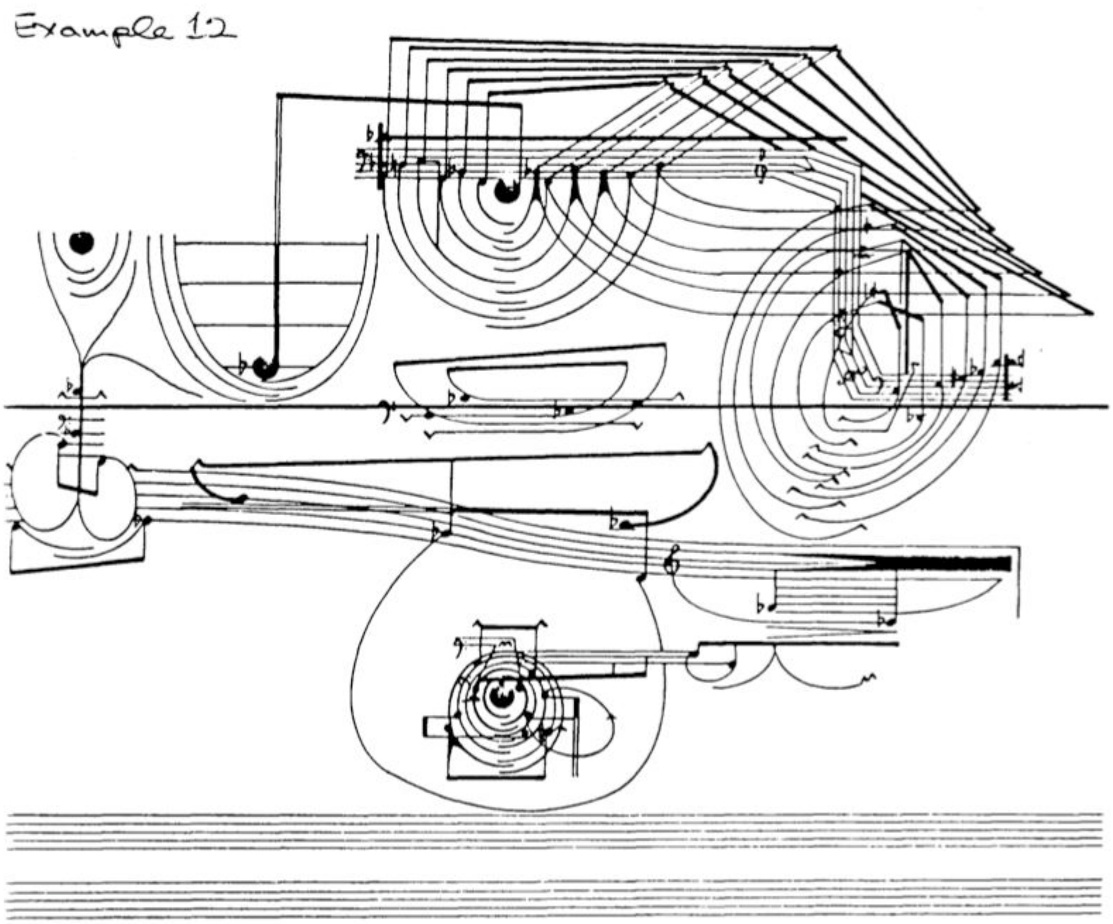
- Cornelius Cardew: *Treatise* 1963-1967 (Dennis 1991, p. 24)



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19.19. Voltage as a Control Language

- Modular synthesizers used voltages to transmit control information
- Control information could be continuous parameter changes (a varying voltage)
- Control information could include event durations, pitches, and amplitudes
- Control information could include envelope, filter, and oscillator parameters
- No standards for voltage control between manufacturers
    - Ranges and mapping of volts were often different between devices
    - Example: 1 volt per octave, 1/3 volt per octave, or volt to Hz mapping

19.20. MIDI: Motivation

- Inconvenience and unreliability of voltage signals

- Desire to save and store control information (not audio)
- Desire to control multiple synthesizers from one input interface
- Many manufacturers developed proprietary communication systems: Roland, Oberheim, Sequential Circuits, and Fender Rhodes

19.21. MIDI: History

- 1981: Sequential Circuits (Smith and Wood) propose a Universal Synthesizer Interface
- 1982 (December): First MIDI synthesizer, Sequential Circuits Prophet 600, ships
- 1983: first demonstration of communication between two synthesizers by different manufacturers (Prophet 600 and Roland Jupiter 6)
- 1983 (October): official MIDI 1.0 Detailed Specification published

19.22. MIDI: 1.0 Detailed Specification

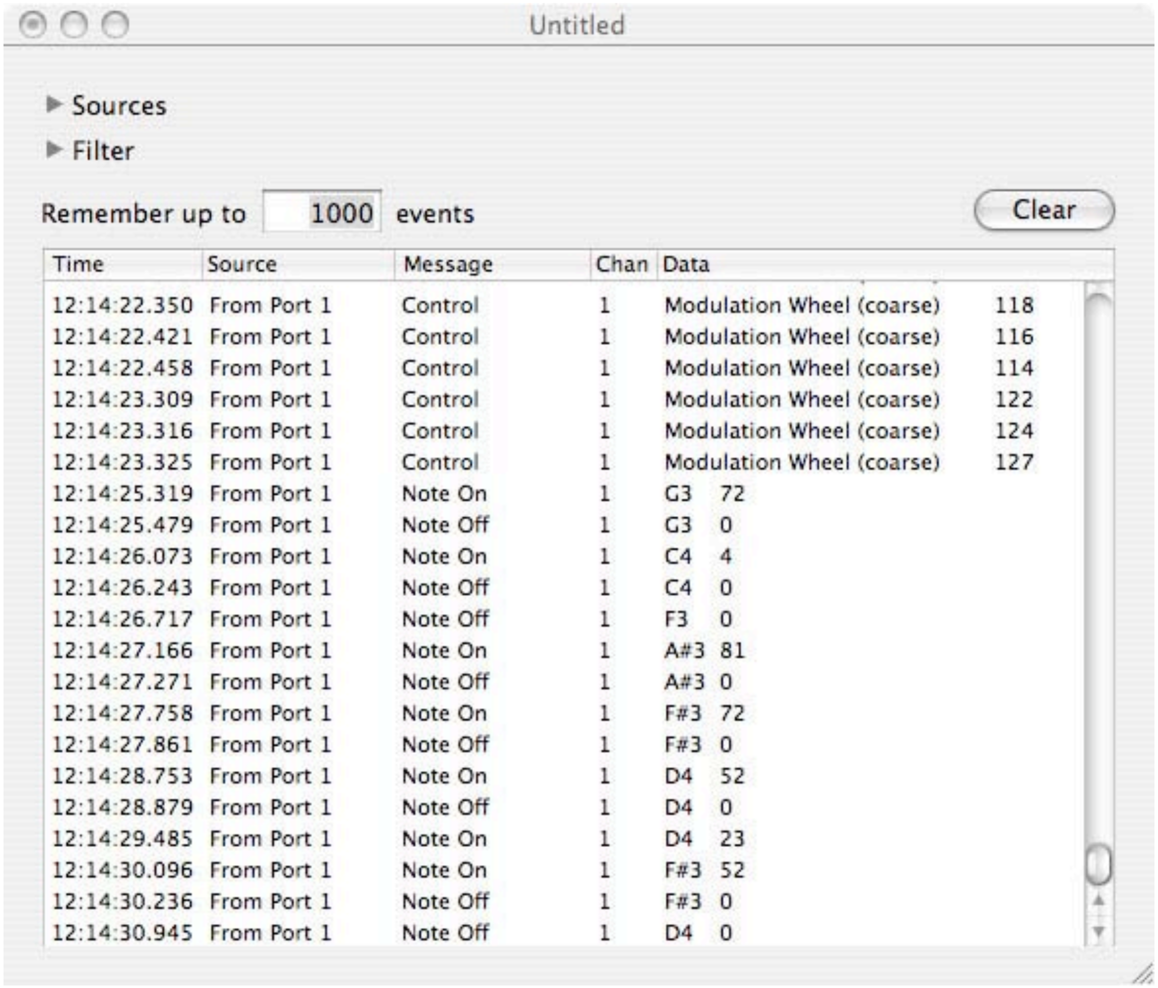
- Compliance with the specification was voluntary
- Designed for universality and expandability
- Designed with un-implemented and un-designed "holes"
- Designed to be cheap: originally assessed to add $5 to $10 to manufacturing prices

19.23. MIDI: A Language for Control Data

- MIDI sends and receives digital control data
- MIDI does not send digital or analog audio
- MIDI provides instructions for producing sounds, not the sounds themselves
- Where digital audio requires lots of data and provides a complete specification, MIDI requires little data and is an incomplete specification
- The quality of MIDI playback is based entirely on the playback device (keyboard, synthesizer, computer, etc.)

19.24. Viewing MIDI Input

- MIDI Monitor



Time	Source	Message	Chan	Data	
12:14:22.350	From Port 1	Control	1	Modulation Wheel (coarse)	118
12:14:22.421	From Port 1	Control	1	Modulation Wheel (coarse)	116
12:14:22.458	From Port 1	Control	1	Modulation Wheel (coarse)	114
12:14:23.309	From Port 1	Control	1	Modulation Wheel (coarse)	122
12:14:23.316	From Port 1	Control	1	Modulation Wheel (coarse)	124
12:14:23.325	From Port 1	Control	1	Modulation Wheel (coarse)	127
12:14:25.319	From Port 1	Note On	1	G3 72	
12:14:25.479	From Port 1	Note Off	1	G3 0	
12:14:26.073	From Port 1	Note On	1	C4 4	
12:14:26.243	From Port 1	Note Off	1	C4 0	
12:14:26.717	From Port 1	Note Off	1	F3 0	
12:14:27.166	From Port 1	Note On	1	A#3 81	
12:14:27.271	From Port 1	Note Off	1	A#3 0	
12:14:27.758	From Port 1	Note On	1	F#3 72	
12:14:27.861	From Port 1	Note Off	1	F#3 0	
12:14:28.753	From Port 1	Note On	1	D4 52	
12:14:28.879	From Port 1	Note Off	1	D4 0	
12:14:29.485	From Port 1	Note On	1	D4 23	
12:14:30.096	From Port 1	Note On	1	F#3 52	
12:14:30.236	From Port 1	Note Off	1	F#3 0	
12:14:30.945	From Port 1	Note Off	1	D4 0	

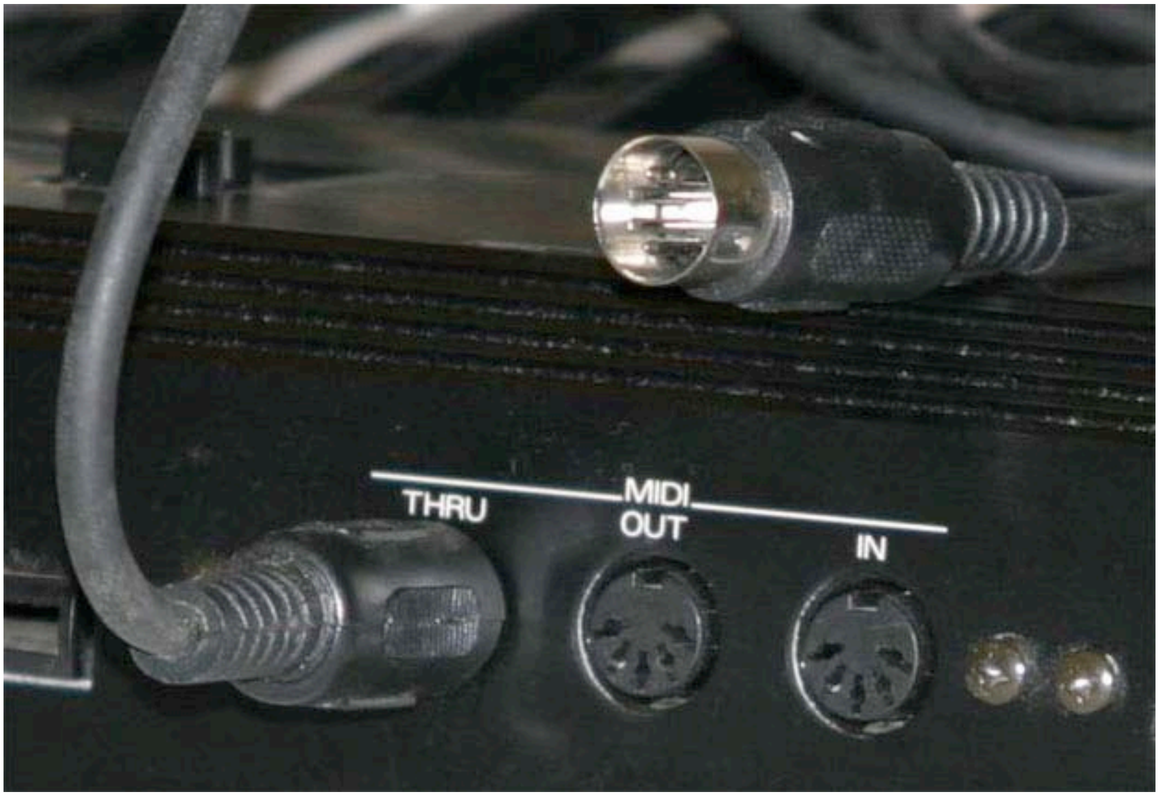
- Observe: when information changes and the range of values
- Note-on, note-off and control change messages

19.25. MIDI: Features: Bits, Bytes, and the Serial Interface

- Serial: sends one message at a time in one direction
- A message is usually two or three bytes
- Each byte is eight bits (a series of 8 ones or zeros)
- Each byte can encode 256 possible values (2^8)
- MIDI specifies the meaning and ordering of messages
- MIDI can pass messages as a stream, or store messages in a file

19.26. MIDI: Cables and Jacks

- 5-pin DIN connectors



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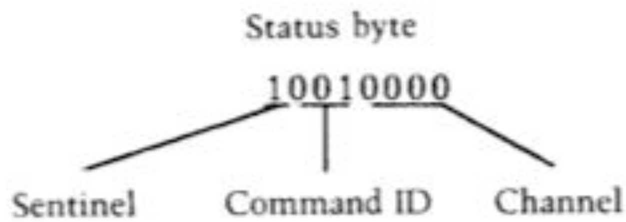
- DIN Cable: Deutsche Industrie Norm, originally used in European audio equipment
- Only three pins are used, only one with data: (5) MIDI signal, (4) bias voltage, (2) shield
- In, out, and thru jacks demonstrate that this is a mono-directional, serial interface
- Often USB (Universal Serial Bus) is used to transmit MIDI

19.27. MIDI: Messages

- A message is (generally) two or three bytes
- A message consists of a command byte and one or two data bytes
- The 256 values of each byte is split in half to distinguish command from data bytes (the MSB as a sentinal bit)

Fig. 9. Channel command layout.



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Computer Music Journal 9, no. 4 (Winter 1985): 8-26.
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- Command byte values are in the range of 128 to 255
- 8 types of command bytes are repeated 16 times, once for each channel
- Single data byte values are in the range of 0 to 127
- Double data byte values are in the range of 0 to 16384

19.28. MIDI: Messages: Example

- Pressing a key on a keyboard is a note-on message
- Message byte 1: Command Byte: type of action (note on) and specific channel
- Message byte 2: Data Byte: the key number pressed
- Message byte 3: Data Byte: the velocity of the key pressed
- Binary: 10010000 01000101 01100101
- English: Note on, pitch F above middle C, with a velocity of 101

19.29. MIDI: Channels

- Channels permit different devices to tune in to different information
- All information is passed through the same cable, in the same stream

- Multiple MIDI cables can be used for more as many as 128 channels

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19.30. MIDI: Command and Data Bytes

- Note Off for channels 1 to 16: 128-143; requires two data bytes (note number, velocity)
- Note On for channels 1 to 16: 144-159; requires two data bytes (note number, velocity)
- Other command bytes: Key Pressure, Control Change, Program Change, Channel Pressure, Pitch Bend, System Exclusive
- System Exclusive messages permit sending arbitrary-length data to any device
- Summary of commands (Loy 1985, p. 15)

Table 1: Summary of MIDI codes

Status	Arg 1	Arg 2	Mnemonic
		CHANNEL COMMANDS	
80	Key	Velocity	Key off
90	Key	Velocity	Key on
A0	Key	Pressure	Polyphonic key pressure (*after-touch*)
B0	Index	Value	Control change
C0	Index	(None)	Program change
D0	Pressure	(None)	Pressure (*after-touch*)
E0	LSB	MSB	Pitch wheel change
		SYSTEM EXCLUSIVE COMMAND	
F0	Mfg. ID	. . .	System exclusive command
		SYSTEM COMMON COMMANDS	
F2	LSB	MSB	Program position select
F3	Index	(None)	Program select
F6	(None)	(None)	Tune request
F7	(None)	(None)	End of system exclusive
		REALTIME COMMANDS	
F8	(None)	(None)	Timing clock
F9	(None)	(None)	Undefined
FA	(None)	(None)	Start
FB	(None)	(None)	Continue
FC	(None)	(None)	Stop
FD	(None)	(None)	Undefined
FE	(None)	(None)	Active sensing
FF	(None)	(None)	System reset

Note: All values are in hexadecimal notation. See the text for a further description.

Source: Loy, G. "Musicians Make a Standard: The MIDI Phenomenon."
Computer Music Journal 9, no. 4 (Winter 1985): 8-26.
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19.31. MIDI: Control Change Commands

- Incorrectly called continuous controllers (not continuous)
- Commonly used for a wide range of dynamic parameter values: panning, volume, modulation, expression
- Two data bytes: type of controller (128 values), controller value (128 values)
- First 64 controllers designed to permit sending two data bytes to provide double resolution (16384 values)

19.32. Reading: Loy

- Loy, D. G. 1985. "Musicians Make a Standard: The MIDI Phenomenon." *Computer Music Journal* 9(4): 8-26.
- Does Loy suggest that MIDI comes from a particular standpoint or bias?
- Does Loy approach MIDI from a particular standpoint or bias?
- What are the misconceptions Loy wants to address?

19.33. Configuring a MIDI Controller

- Most controllers can be configured to send various MIDI messages
- Korg Kontrol Editor for Korg nano series

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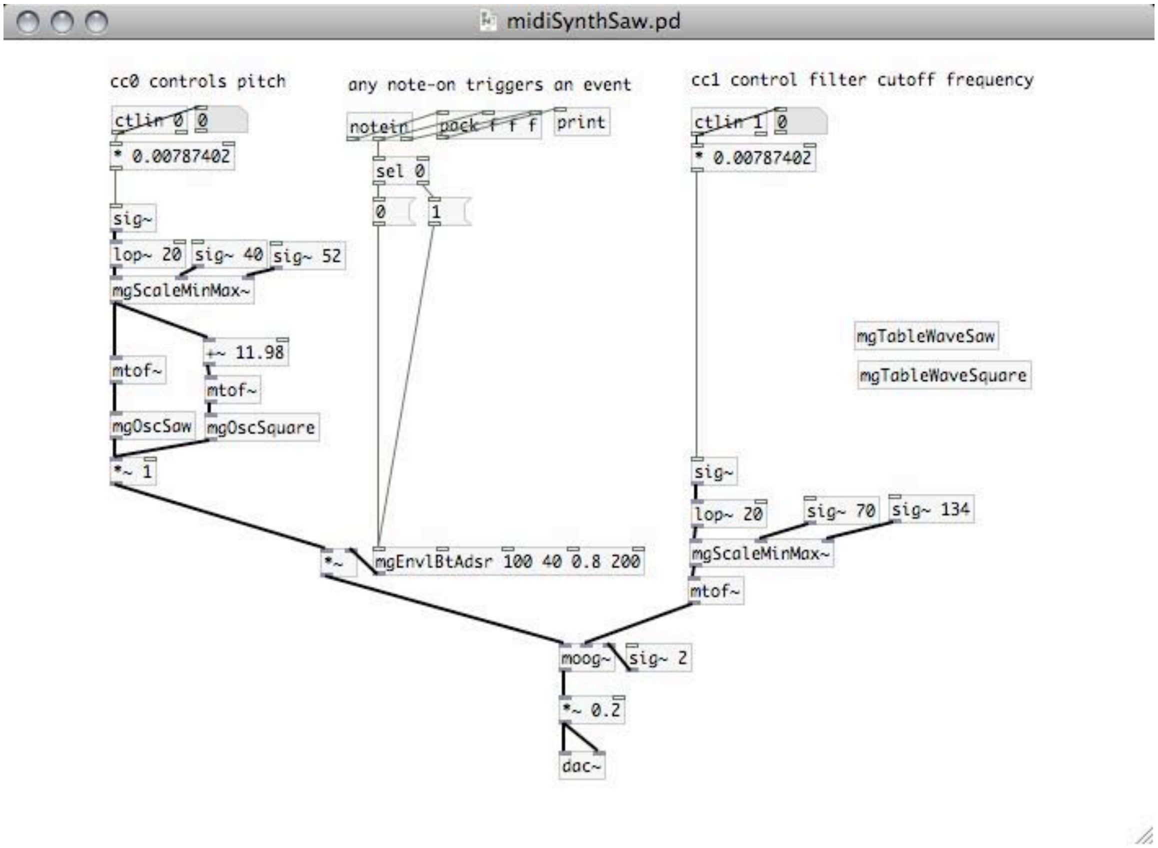
- Basic synthesizer employing continuous controllers for pitch and LPF cutoff frequency; note-on/off message start envelope [instruments/midiSynthSaw.pd]



19.34. Open Sound Control: OSC

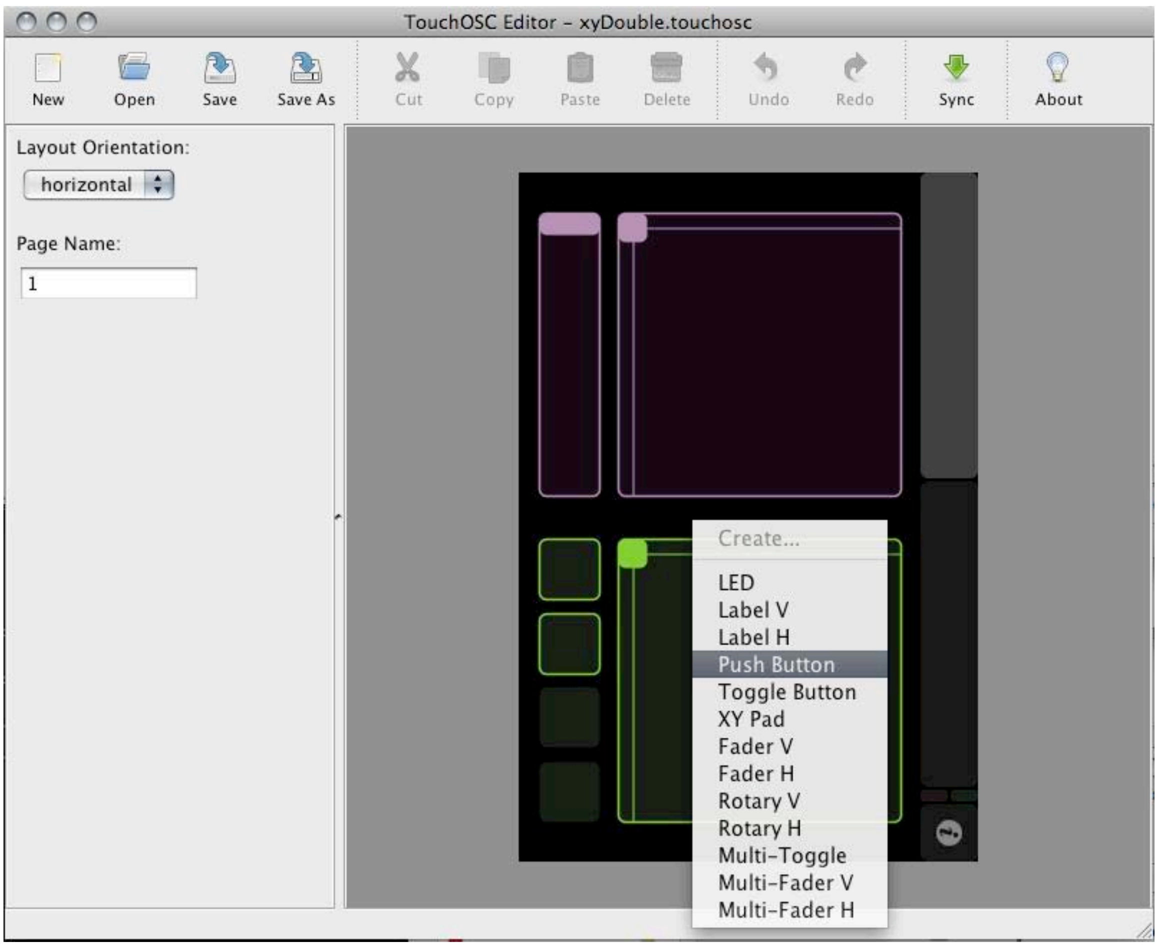
- OSC: Open Sound Control, first released in 1997 (Wright and Freed 1997)
- Open, extensible networking protocol using User Datagram Protocol (UDP) or TCP/IP
- Entities (parameter fields) named with open-ended, URL-style, symbolic, hierarchical address space (Wessel and Wright 2002, p. 17)
- User- and system-definable name spaces
- Messages can be time tagged to permit sending message for later scheduling and performance
- Significant advantage over MIDI is in freedom of parameter organization and labeling

  "... we wanted to name our control parameters as we designed them rather than pick from control parameter names pre-seelcted by the author of a networking protocol" (Wessel and Wright 2002, p. 18)

"... we wanted to organize the control interface according to project-specific structures without being bound by fixed architectures such as 'notes' within 'channels'" (Wessel and Wright 2002, p. 18)

19.35. Configuring an OSC Controller

- TouchOSC Editor: design custom interfaces for sending OSC messages via iPod Touch / iPhone



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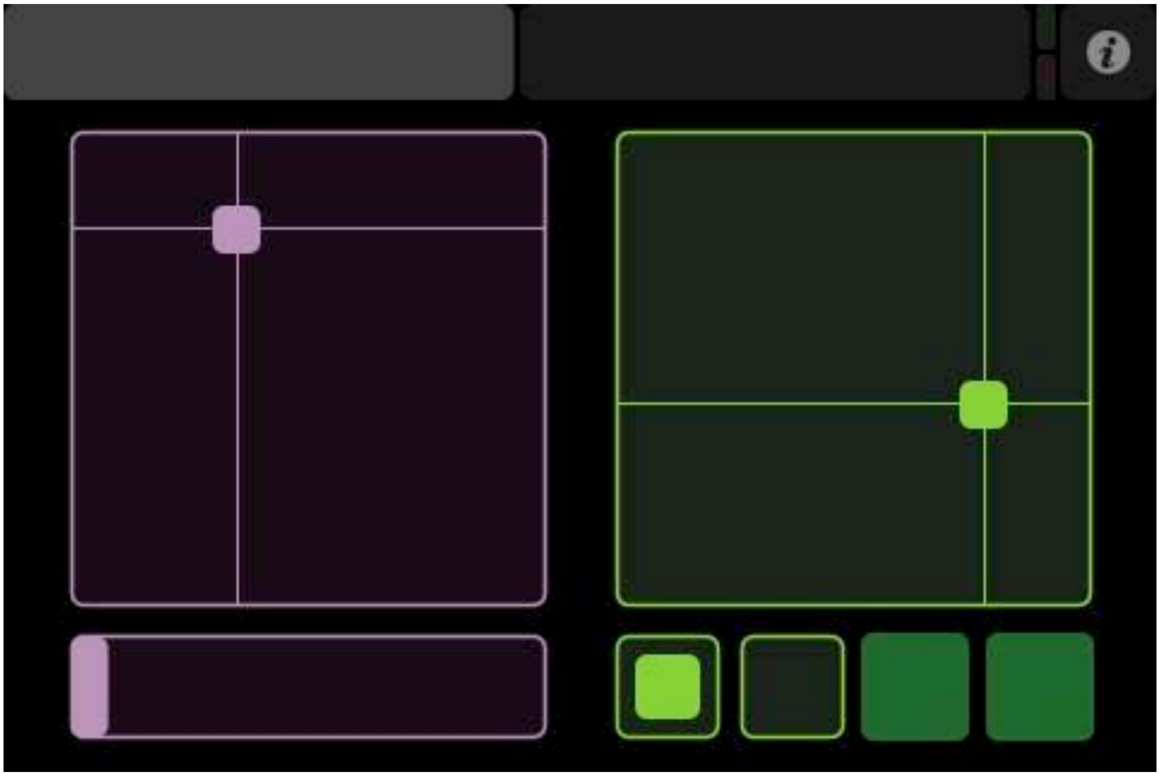
- Double XY pad control for filtered noise

  Note clear organization and labeling of OSC parameter values



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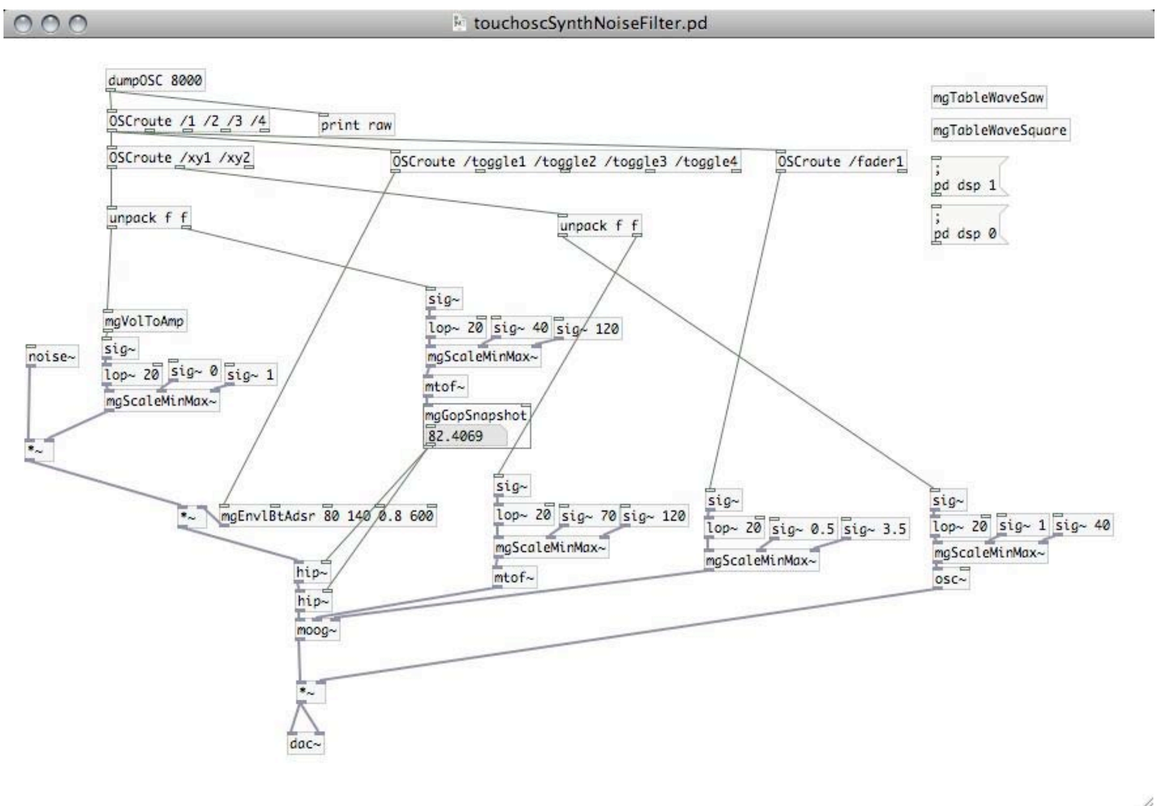
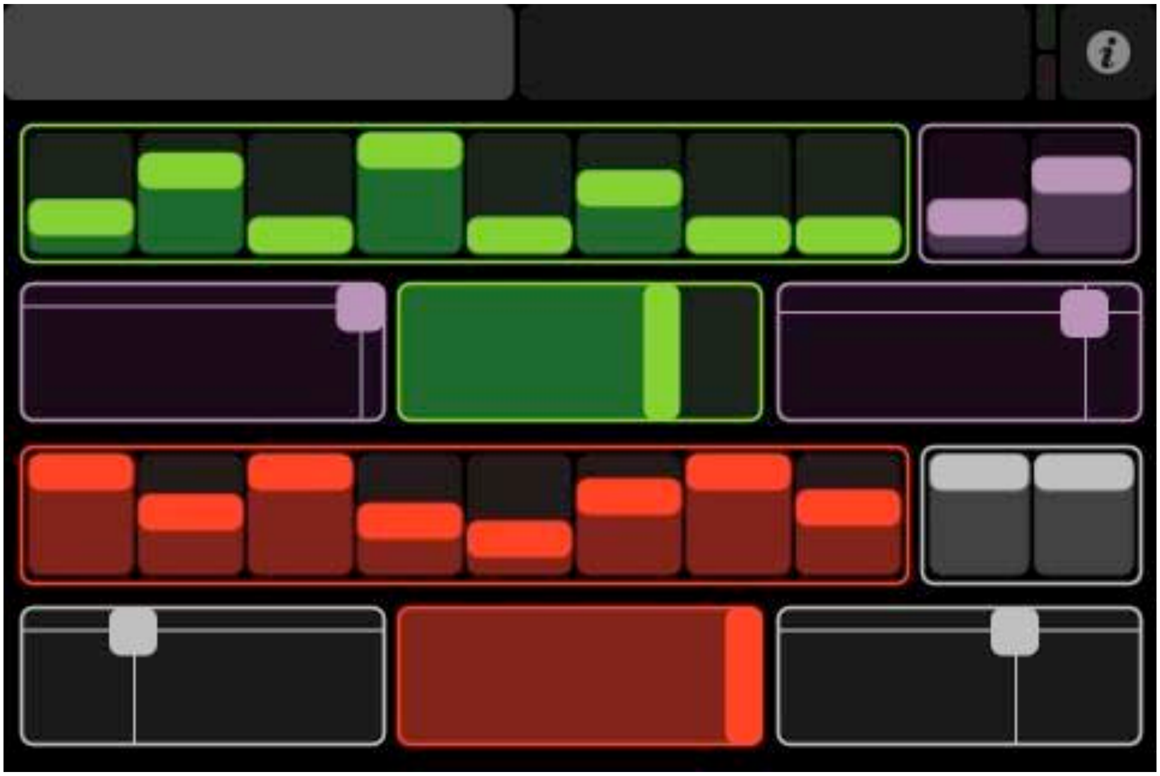


- Double 8-step sequences with cycle length (1-8), beat multiplier (1-8), double XY pad control, and level control.



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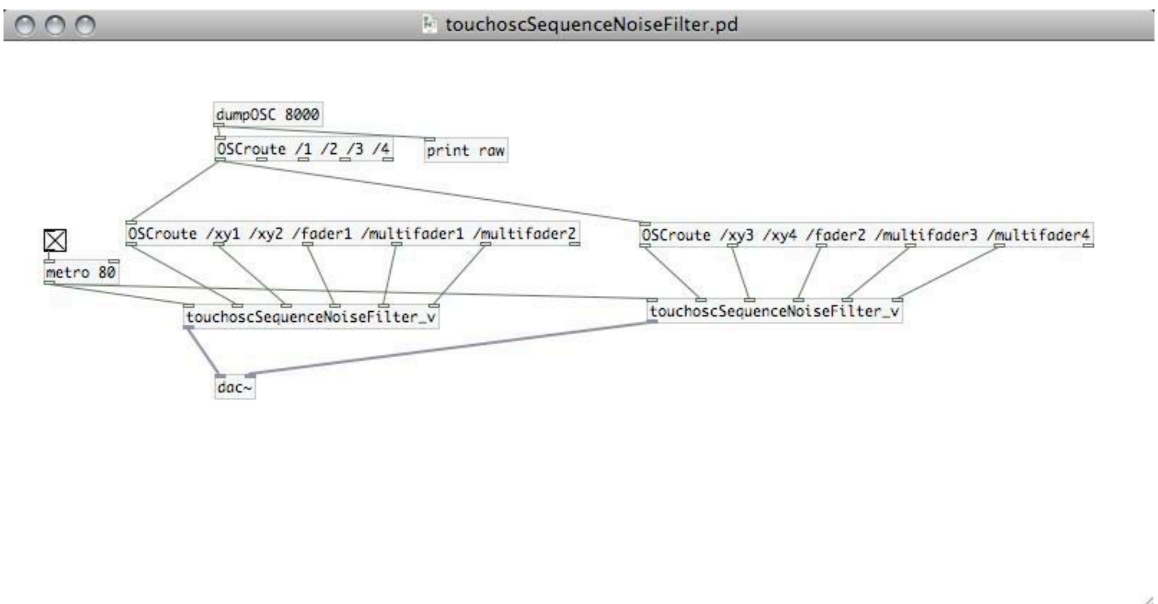

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