Chapter 10. Meeting 10, Interfaces: Mechanical Automations and Innovations

10.1. Announcements

• Music Technology Case Study Draft due 3 November

10.2. Interfaces and Instruments

• A musical interfaces is a place of interaction between sound production and/or compositional ideas

• An interface, more than sound production method, quantity, or source, defines an instrument

10.3. The Organ

• A wind instrument controlled by a keyboard and pedals

• Sometimes with multiple manuals (keyboards) and stops (timbral controls)

• With the clock, one of the most complex mechanical devices developed up until the 19th century

• A locus of technological innovation: new technologies quickly adapted and incorporated

• A very old “unnatural” and “modern” instrument

  • Bellows permit continuous sound

  • Tuned pipes provide fixed pitch

  • Multiple interface types: multiple manuals, pedals, and stops

  • Custom instrument installation motivates diverse designs

10.4. The Organ: Valves as Triggers and Selectors

• Modern single-manual organ with suspended action
Image removed due to copyright restrictions.
"Key- and stop-mechanism of a single-manual organ with suspended action"
from Grove Dictionary of Music (Online).
• By pulling different stops, the operator could change the timbre of the instrument while playing
• Switches and slides (in addition to keys) become a musical interface

10.5. The Organ: The Hydraulic Organ (Hydraulis)

• Greeks explored pneumatics and hydraulic devices: Hero of Alexandria
• The hydraulis, hydraulos, hydraulus or hydraulα: a Greek invention of 3rd century BCE
• Possibly invented by Ctesibius of Alexandria in 246 BCE
• Wind supply to the pipes regulated by water pressure

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Heron's Windwheel. (1899, public domain, via Wikipedia.)
10.6. The Organ: Bellows and the Need for Air Pressure

- Need for regular air pressure leads to numerous technological solutions
- Late 15th century
• 18th century multifold bellows

YouTube (http://www.youtube.com/watch?v=qecBF1beTmY)

• Mid 19th century: steam power

Calliope

YouTube (http://www.youtube.com/watch?v=odMCKR54VRc)

• Early 20th century: electrical fan blowers
10.7. Electroacoustic Keyboard Instruments

- Electroacoustic instrument: acoustic sounds are electronically amplified
Common approach to use brass reeds that vibrate and are then amplified with pickups

1934: Everett Orgatron

1947: Wurlitzer electric piano, based on Orgatron, produced in New York

YouTube (http://www.youtube.com/watch?v=3bGqHuJoB9M)

YouTube (http://www.youtube.com/watch?v=2aEL5AQQ2fQ)

Rhodes, Wurlitzer, Clavichord
• Internals of the Rhodes

YouTube (http://www.youtube.com/watch?v=cZW00m81WW8)
10.8. Hammond B3: History

- 1935: Laurens Hammond with his instrument
- 1939: Hammond demonstrates B3 at AES in New York
- Two 61 note keyboards
• 400 pounds

10.9. Hammond B3: Technologies

• 91 tone wheels: rotating discs that electro-magnetically generate a tone

• Similar to a dynamic microphone, tone wheels generate a tone through electromagnetic induction
• Two sets of 9 drawbars

• Drawbars control amplitude of harmonics: sub-octave, unison, 8th, 12th, 15th, 17th, 19th, 22nd
• Drawbars provide an interface to additive synthesis

• Required external amplification

• Examples

  YouTube (http://www.youtube.com/watch?v=vQUr-TKC76g)

  YouTube (http://www.youtube.com/watch?v=0nsPgSl52qY)

10.10. Hammond B3: Dynamic Timbre Control

• Drawbars permit dynamic timbre: sliders instead of stops

• Drawbars become an interface

• Hammond XK-3 ($2195): 96 Digital Tone Wheels/Vacuum Tube
• Native Instruments B4 ($199): Virtual Instrument

• Native Instruments B4D
10.11. Listening: Jimmy Smith and Wes Montgomery


- What gives Jimmy Smith’s solo (from 2:26) a compelling forward momentum?

10.12. Listening: Medeski, Martin, and Wood

How is the sound of the Hammond transformed, and to what creative ends?

10.13. The Player Piano: History

- late 1800s: Barrel piano: stubs on cylinder encode music
- 1804: John Longman introduces drawing-room barrel piano with no keyboard
- 1800s: Portable barrel pianos popular street entertainment
1863: Henri Fourneaux develops Pianista: first pneumatic piano playing machine

1895: Edwin Scott Votey creates the Pianola

1904: Edwin Welte completes first “reproducing piano”

1904: Welte in Germany records a performer for use in creating player piano rolls (2002, p. 84)

1900-1930: 2.5 million instruments sold in U.S.

Gramophones and radio reduced demand by 1930s

Depression up until WWII led to demise of industry


• Pneumatic power: paper-as-a-valve system
Fig. 3: Principle of a player piano

Courtesy of Jürgen Hocker. Used with permission.
Image removed due to copyright restrictions.
Player piano "Reproducing mechanism diagram" from Grove Dictionary of Music (Online).
• Ampico system: 98 tracks per line, 83 for controlling piano notes, 1 track for left pedal, 1 track for right pedal, 6 tracks for controlling bass dynamics, 6 tracks for controlling treble dynamics (Hocker 2002, p. 88)

• Player piano in motion

  YouTube (http://www.youtube.com/watch?v=MhSnUprw7XY)
• Alternative approaches

10.15. Conlon Nancarrow

• Conlon Nancarrow (1912-1997)

• Born in Arkansas, fought in Spain against Franco, emigrates to Mexico

• Influenced by Henry Cowell’s recommendation perform complex rhythms on player piano (Hocker 2002, p. 87)

• Frustrated with limitations of human players

• 1947: Bought a player piano roll cutting machine

• 1949: First original composition for player piano

• Composes 49 studies for player piano

• First 20 studies written out in standard notation (Hocker 2002, p. 90)
- Explored speeds and densities idiomatic to the player piano
  - Player piano: 200 notes / second (Human: 15 notes per second)
  - Player piano: 40 notes at once (Human: 12-15 notes at once)

10.16. Conlon Nancarrow: Music

- Idea of temporal dissonance (Hocker 2002, p. 93)
  
  Examples via Frere Jacques
  (http://willshare.com/willeyrk/creative/papers/study37/tempdiss.htm)

- Often used poly-tempi and poly-meter

- Complex temporal canons

- Precise ratio-based acceleration and deceleration

- Study 2
Example 5. Nancarrow, Study No. 2.
Summary of tempos and material.
10.17. Listening: Conlon Nancarrow

- Conlon Nancarrow: “Study #1”

- Conlon Nancarrow: “Study #36”
10.18. Reading: Hocker


- How is the composer’s interface altered if permitted to draw compositions on paper rolls?

- Is unplayability an important feature for Nancarrow?

10.19. Ideas of a new Music

- 1907: Ferruccio Busoni: *Outline of a New Aesthetic of Music*

- 1910-1912: Manifesti of Ballila Pratella

- 1913: Russolo: *Art of Noises*

- 1919-1930: Henry Cowell: *New Musical Resources*

10.20. Reading: Brown


- From where did Russolo get his inspiration?

- What was the basic sound producing mechanism of the intonarumori
Public domain photo.
• What was the interface of the Intonarumori?
• What were Russolo’s goals of developing and extending the Intonarumori?

10.21. Reading: Bijsterveld


• Was Russolo a (sonic/musical) revolutionary?

• What motivated Russolo to say the following: “... the ear must hear these noises mastered, servile, completely controlled, conquered and constrained to become elements of art” (2002, p. 124)

• What were some of the criticisms of Russolo’s instruments and compositions?

10.22. Listening: Russolo

• Listening: Luigi Russolo, “Intonarumori: crepitatore (crackler),” 1977

• Luigi Russolo, “Intonarumori: gorgogliatore (gurgler)” 1977

• Luigi Russolo, “Risveglio di una Citta (Extract),” 1977