Chapter 7. Meeting 7, Recording: Processing Audio and the Modern Recording Studio

7.1. Announcements

• Quiz next Thursday
• Numerous listenings assignments for next week

7.2. Processing Audio

• Contemporary processors take many physical forms: effects units, stomp-boxes
Photo courtesy of kernelslacker on Flickr.
Photo courtesy of michael morel on Flickr.

Courtesy of George Massenburg Labs. Used with permission.
• As software, most are implemented as plug-ins
7.3. Distortion

- Pushing a signal beyond its dynamic range squares the waveform
- Making round signals more square adds extra harmonics [demo/processorsDistortion.pd]
• Examples
  • Overdrive
  • Fuzz
  • Crunch

7.4. Dynamics Processors

• Transform the amplitude of a signal in real-time

• Amplitudes can be pushed down above or below a threshold to decrease or increase dynamic range

• Examples
• Compressors and Limiters
• Expander and Gates

7.5. Dynamics Processors: Compression

• Reduces a signal’s dynamic range
• Makes the quiet sounds louder
• Helps a track maintain its position in the mix
• Two steps
  • Reduce dynamic range: turn amplitudes down if above a specific level (the threshold)
  • Increase amplitude of entire signal so that new peaks are where the old were
To be compressed

Uncompressed Peak

Threshold

Compression occurs

Previous 0 VU

Threshold

0 VU

Boost overall level

Figure by MIT OpenCourseWare.
• Negative effects: can increase noise, and create dynamic noise floors
• Negative effects: can make a musical part dynamic static

7.6. Filters

• A filter alters the timbre of a sound
• Some frequency components are boosted, others are cut [demo/processorsFilters.pd]

• The low pass and high pass filter
  • Cutoff frequency determines where the filter is active
  • May have a resonance control at the cutoff frequency
• Can be thought of as smoothing the waveform
• An easy filter to implement in analog and digital electronics
• The parametric filter
  • Center frequency, bandwidth (Q), and gain
  • The most precise filter

7.7. The Channel Strip

• A channel strip bundles together common musical processors
• A mixer (as hardware or software) consists of many parallel channel strips (and flexible ways to combine them)
• Filters are always included

• Dynamic effects may also be found: compressors and gates
• Mackie 1604 channel strip
• Mackie 2480 channel strip
• SSL 900 channel strip
7.8. Delay

- Place signal in a buffer, wait, then send out [demo/processorsDelay.pd]

- Feedback: scale the amplitude of the delayed signal and then delay it again: creates a series of echos

7.9. Time-Variant Delays

- Vary the delay time with a time-varying signal (like a control-rate sine)

- Creates change in timbre through phase interference [demo/processorsDelayVariable.pd]
• Examples
  • Chorus
  • Flanging
  • Phasing

7.10. Dense Delay Structures

• Organized groups of very close spaced delays [demo/processorsDelayDense.pd]
• Less than 30 ms separation between echos will produce a continuous sound

• Examples
  • Chambers and Ambiences
  • Reverb
  • Plates, springs

7.11. Listening: The Southern Four and Parliament

• The Southern Four: “Swing Low, Sweet Chariot,” 1924, Edison Diamond Disc
7.12. The Mothership Connection

- “Starchild, Citizens of the Universe, Recording Angels...,” “Swing down, sweet chariot. Stop, and let me ride”

- Afro-Futurism: African American strategies to overcome racial and social classification by means of technology and futuristic mythology
  - 1956: Sun Ra
  - 1970s: Parliament and George Clinton
  - 1982: Afrika Bambaataa
  - Paul Miller a.k.a. DJ Spooky that Subliminal Kid

- The Mothership Connection: the chariot of “Swing Low, Sweet Chariot” transformed into an interplanetary vessel

- Parliament: “Mothership Connection (Star Child),” 1976

7.13. Multitrack Recorders and DAWs

- Multitrack recording permits recording parts in layers
- Permits recording one track while monitoring (playing back) others
- Punching-in: permits replacing segments of each track
- Overdubs: permit adding additional tracks
- Digital Audio Workstations (DAWs) are software multitrack recorders that permit greater editing flexibility and integrate audio mixing and processing
- Common DAWs: Pro-Tools, Cubase/Nuendo, Logic, Digital Performer, Sonar, Fruty Loops, Live

7.14. Non-Destructive Recording and Non-Linear Editing

- Audio data is recorded and stored on hard disk
• DAW tracks present a representation of a segment of the audio data (an audio region)
• The original audio is never cut or transformed
• Multiple regions can be deployed in multiple tracks without copying or duplicating audio data
• Offers efficiency, flexibility, and security

7.15. Modern Recording, A Three Step Process

• 1. Tracking (recording, overdubs)
• 2. Mixing (editing, cutting, processing, producing)
• 3. Mastering

• Each step may be done at different locations or studios
• Each step may be done in analog or digital
• CDs used to encode which step was analog or digital with a Society of Professional Audio Recording Studios (SPARS) Code

7.16. Division Between Control Room and Recording Rooms

• Recording to tape permitted monitoring what was actually being recorded as it was being recorded
• Main rooms and isolation booths: spaces to position and isolate performers
• Control room: acoustically treated space for critical monitoring of what the microphones are picking up
• Control room monitors are designed to be very accurate speakers
• Sony/Tree’s Music Studio, Nashville
• Paisley Park’s Studio A

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• Studio X, Seattle
7.17. Close Microphone Captures and Track Isolation

- Goal of isolating each musical part in a separate track
- Use of specialized microphones placed very close to performers
- May record each instrument in isolated rooms or at different times
- May record multiple instruments in the same room, with dividers and microphones placed for greatest isolation

7.18. Problems and Benefits of Track Isolation

- Poses challenges to conventional musical communication: musicians need to hear and see each other
- Musicians may need to use ear-phones to monitor other musicians, processed sounds, or pre-recorded tracks
- Permits optimizing sound of each instrument
- Permits correcting errors in single parts
- Permits non-linear recording and audio production
- Permits musical re-arrangement and re-composition
7.19. Mixing and Automation

- Mixing can include fading and switching tracks on and off; adjusting levels, effects processing, filtering, and panning
- Before multi-track tape recording, mixing was done in real-time, direct to disc
- With multi-track tape recording, tracking and mixing became separate steps

7.20. Mixing and Automation: Control Surface

- Mixing consoles used to store processing power and provide an interface
  - Soundcraft MH3 ($16k+)
- Control surfaces provide a dynamic interface to computer-based processing
- Digidesign ProTools D Command ($14k+)
7.21. Mixing and Automation: Traditional and Contemporary

- Traditional mixing is more like performing
  - After all tracks were recorded, engineers would create a script of changes to make during playback
  - Playing back all tracks, the mixing engineer would perform all changes in real time
  - Would likely do multiple takes of the mixing procedure, possible with multiple people performing the mix

- Contemporary mixing is more like composing
  - Track automation permits recording or directly specifying all dynamic changes to channel strip controls and effects
  - The mixing engineer might perform the mix, and then edit the performance data
  - The mixing engineer might directly specify (draw) the dynamic changes
  - Can compose and refine mix automation data

7.22. Tom Dowd: Engineering Innovator

- Video: Tom Dowd: The Language of Music, Chapter 2 (00:02-01:16, 2:42-3:47, 4:10-5:08)
  - Video: Tom Dowd: The Language of Music, Chapter 7 (3:40-7:05)

7.23. Mastering for Distribution and Broadcast

- Process two channel mix to optimize audio performance on various mediums
- Processing tools may include special filters and compressors
- A necessary step to make tracks “gel” together
- Increases loudness of mix
7.24. The Loudness War

- Compete for attention by making music (or other audio programs) louder than adjacent audio programs
- Radio broadcasts: for transmission efficiency and to be louder than competition
- TV commercials: to be louder than the program and other commercials
- Popular Music: to sound bigger than other recordings
- Potential Negative Effects
  - Can distort musical dynamics and reduce musicality
  - Can lead to increasingly extreme dynamics
  - Can train listeners not to hear dynamic range
  - Can cause ear strain
  - Makes diverse playlists difficult to listen to.

7.25. Loudness War: Statistics

- Statistical Evidence:
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<th>Track</th>
<th>Notes</th>
<th>Artist</th>
<th>Year</th>
<th>Slow avg. [dB]</th>
<th>Max. dig. [dB FS]</th>
<th>Hot spots</th>
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7.26. Loudness War: Listening

- The Roots: Ital (The Universel Side) (Illedelph Halflife, 1996)
- The Roots: Guns are Drawn (The Tipping Point, 2004)
7.27. Reading: Horning


• What are some of the large-scale trajectories Horning illustrates over the life of the Cleveland Recording Company?

• What tools and approaches were borrowed from German audio engineers?

• What sort of technologies did Hamann develop?

• Horning describes recording studio innovation as contingent, multi-causal, and decentralized: explain her use of these terms.