

## 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



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- As software, most are implemented as plug-ins



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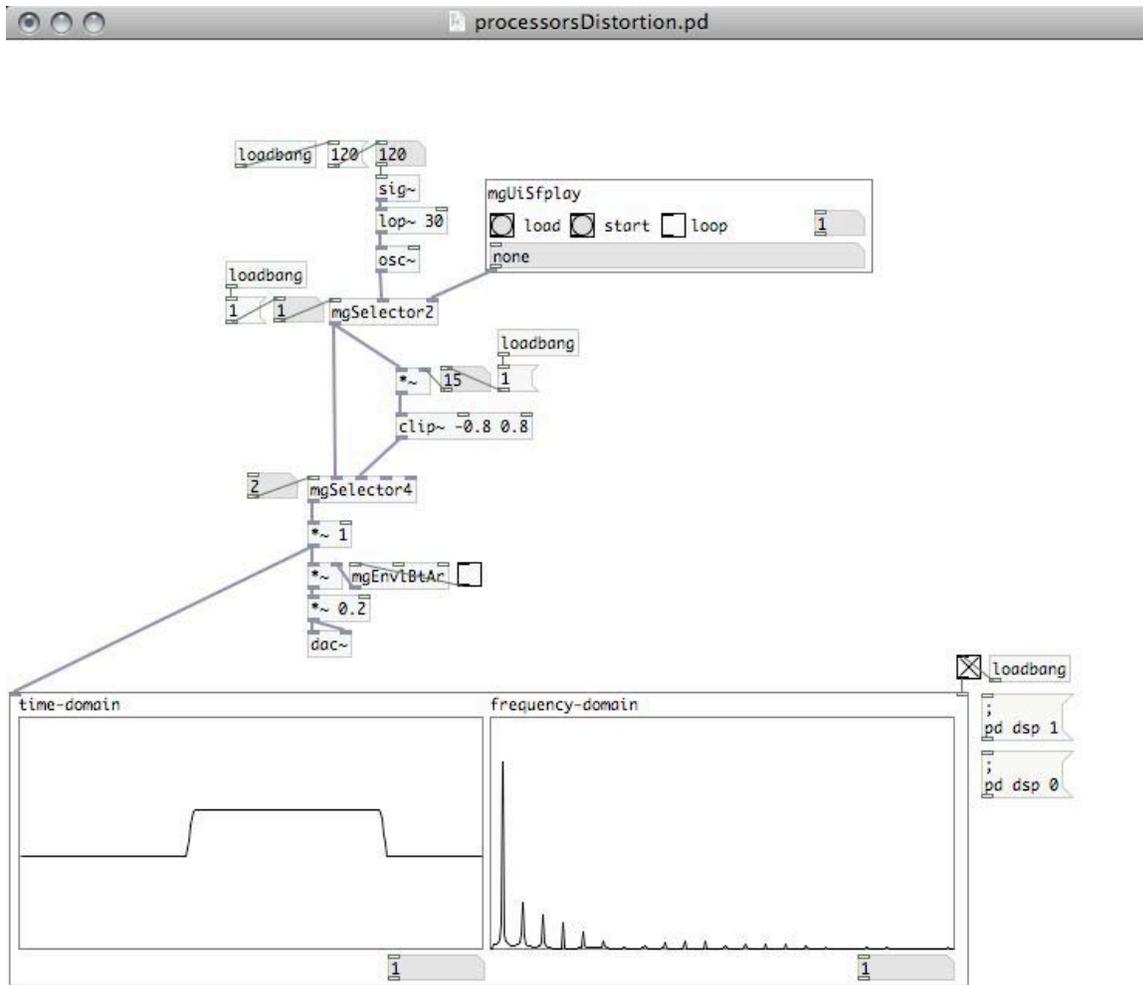
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### 7.3. Distortion

- 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
- Expanders 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 a above a specific level (the threshold)
  - Increase amplitude of entire signal so that new peaks are where the old were

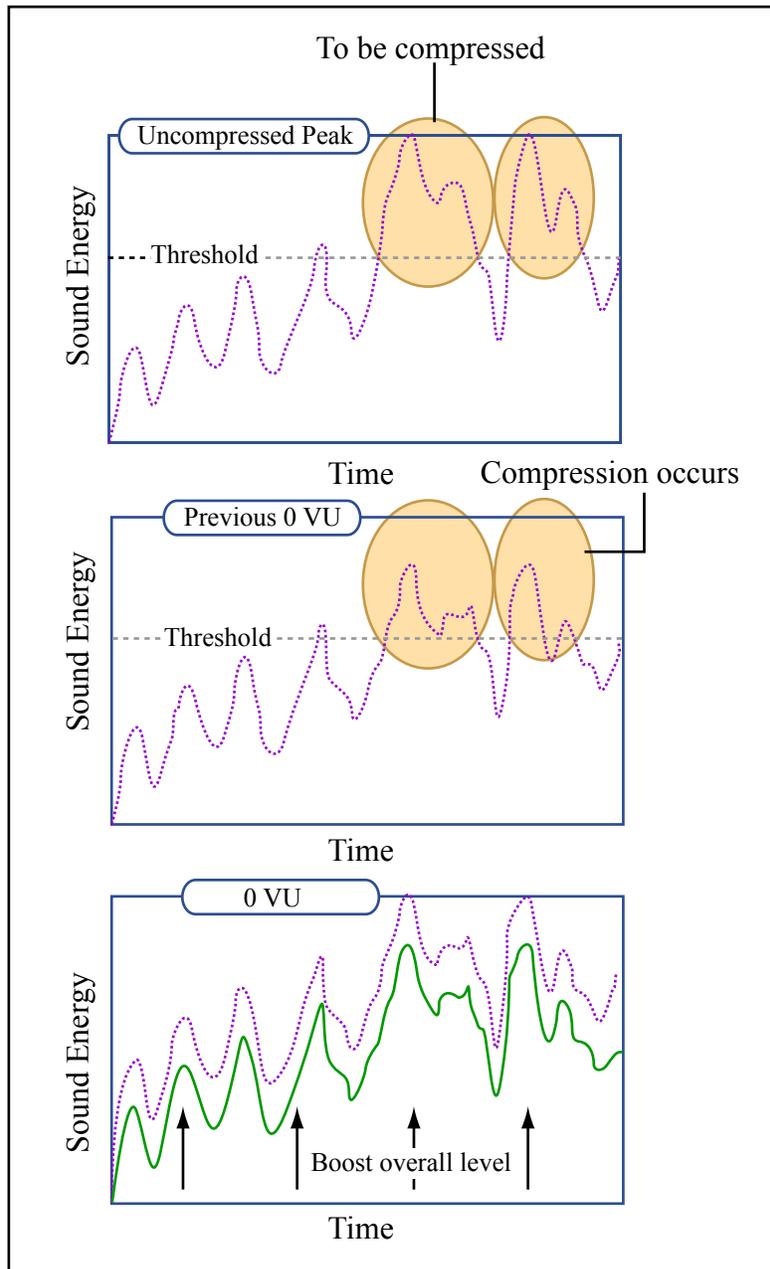
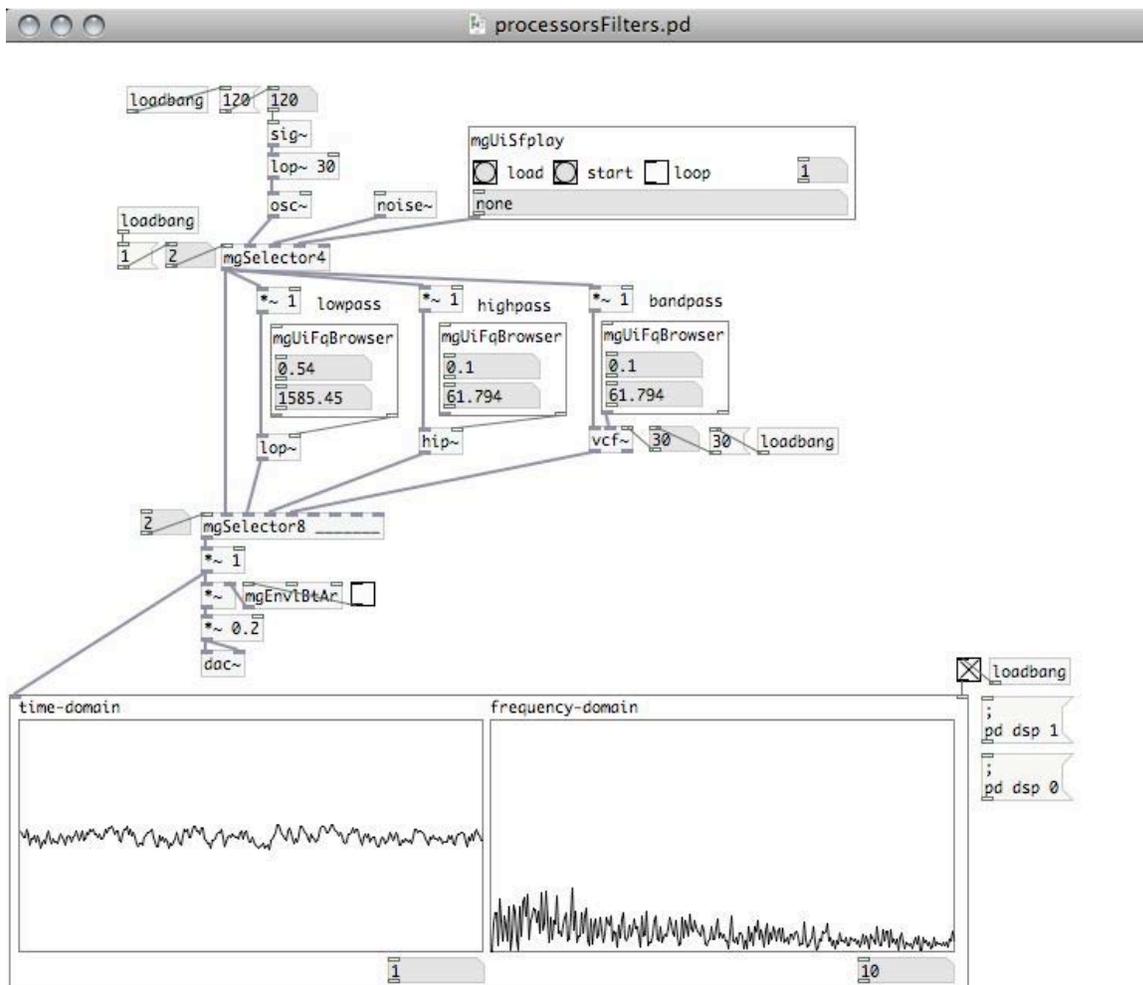


Figure by MIT OpenCourseWare.

- 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**

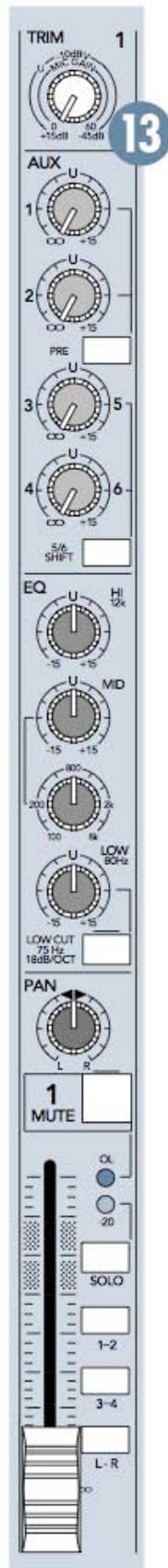
- A channel strip bundles together common musical processors
- A mixer (as hardware or software) consists of many parallel channel strips (and flexible ways to combine them)



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- Filters are always included
- Dynamic effects may also be found: compressors and gates

- Mackie 1604 channel strip



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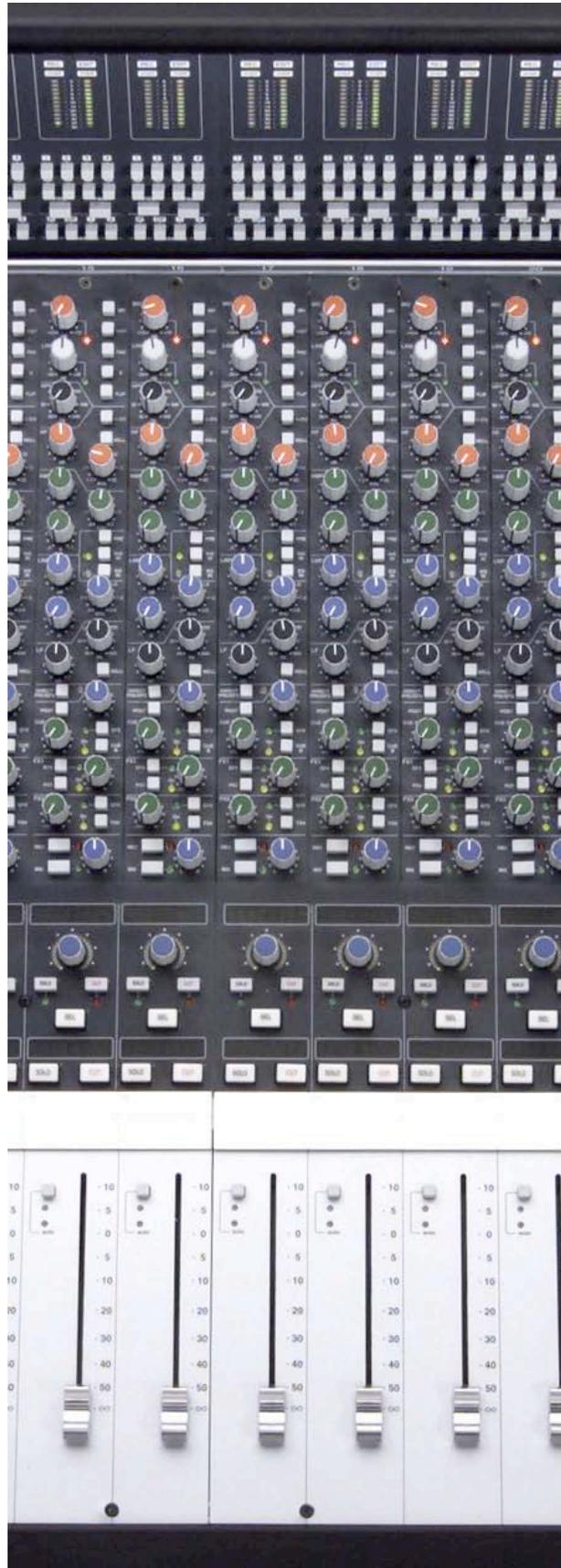
- Mackie 2480 channel strip



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- SSL 900 channel strip

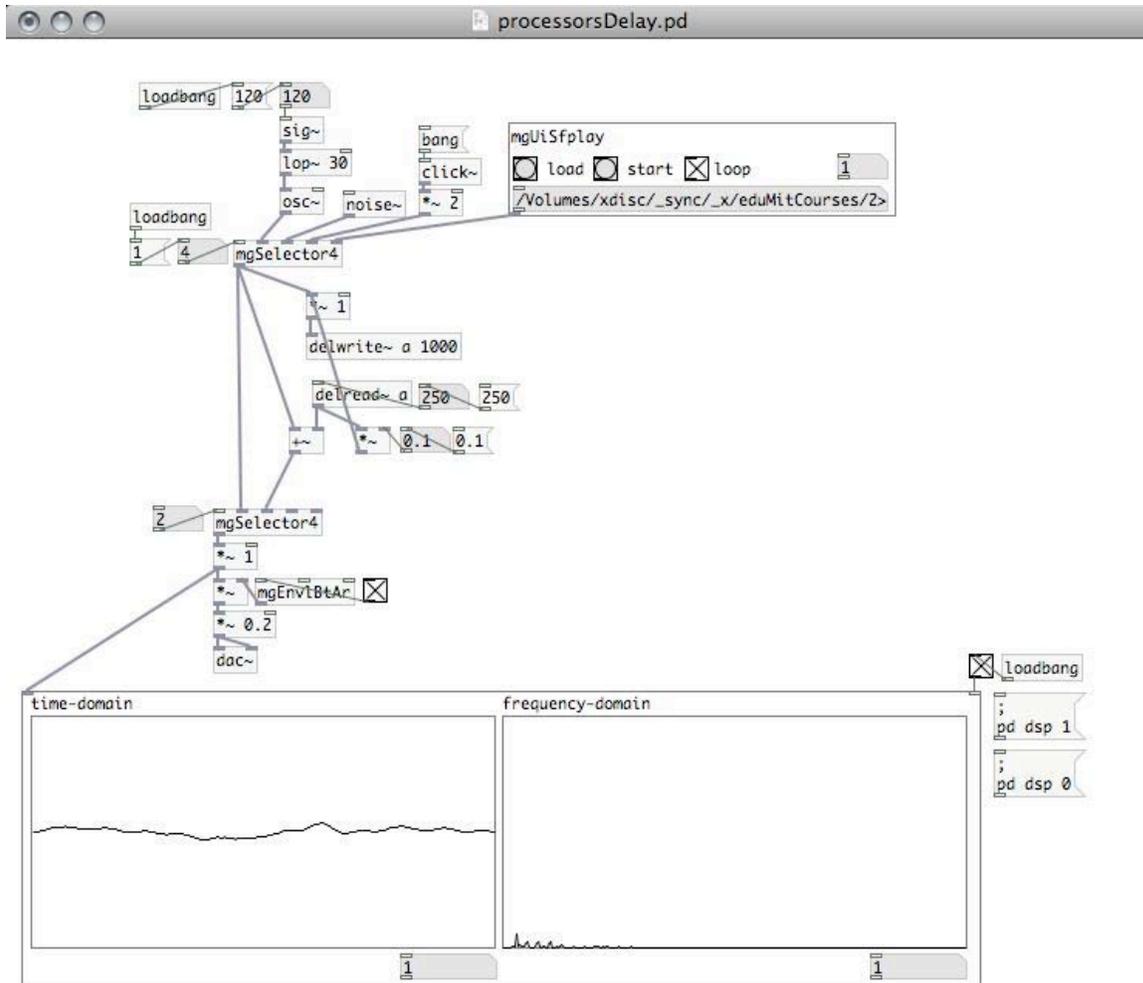


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## 7.8. Delay

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

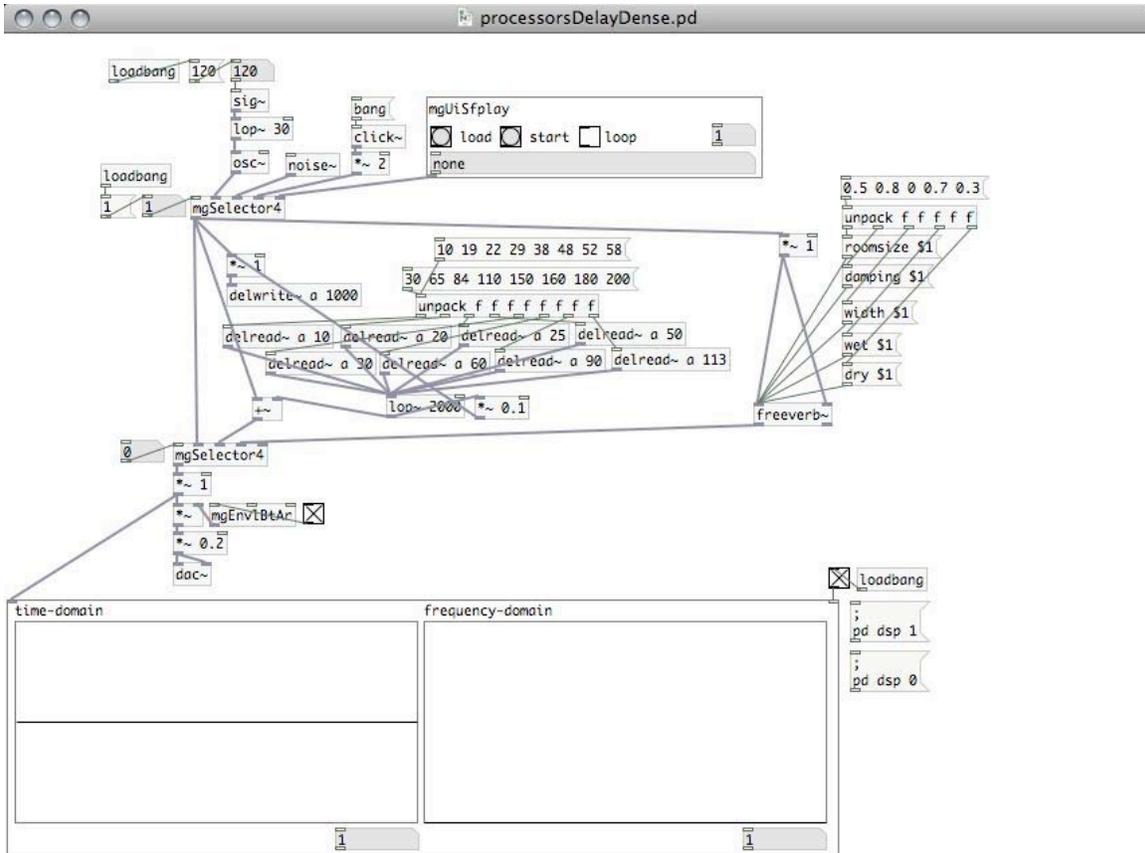


- Feedback: scale the amplitude of the delayed signal and then delay it again: creates a series of echos

## 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]





- 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, Fruity 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

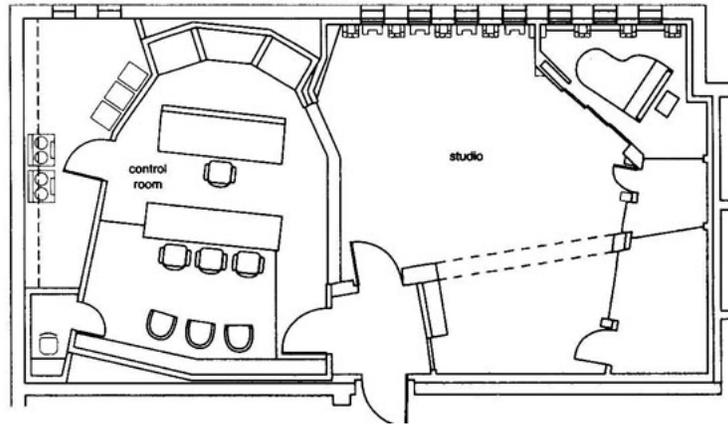
## 7.15. Modern Recording, A Three Step Process

- 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



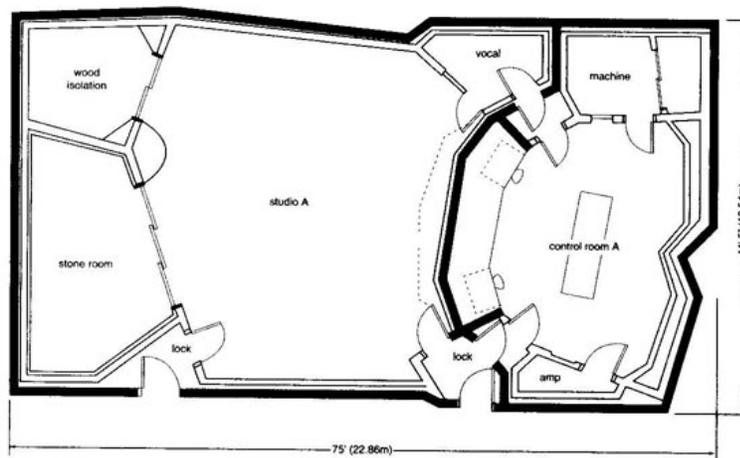
## 7.16. Division Between Control Room and Recording Rooms

- 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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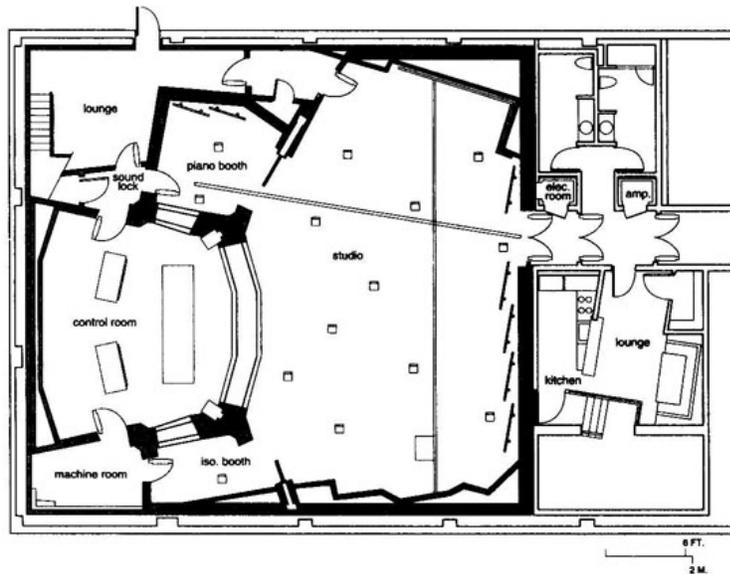


- Studio X, Seattle

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## 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+)



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- Control surfaces provide a dynamic interface to computer-based processing
- Digidesign ProTools D Command (\$14k+)



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## 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

- Nielsen, S. H. and T. Lund. 2003. "Overload in Signal Conversion." *AES 23rd International Conference*.
- Statistical Evidence:

	Track	Notes	Artist	Year	Slow avg. [dB]	Max. dig. [dB FS]	Hot spots 1	Hot spots 2	Sum
1	Lose Yourself		Eminem	2002	-7.5	0.0	>25 s.	>25	4
2	Time of My Life		Macy Gray	2002	-8	0.0	16	8	3
3	Happy		Ashanti	2002	-9	0.0	18	10	3
4	La Fiesta De Amadito		Amadito Valdez	2002	-10	0.0	2	0	1
5	Don't Stop	PP	Anastacia	2001	-6	0.0	>25 s.	15	4
6	Played Alive		Safri Duo	2001	-7	0.0	>25	16	3
7	The Call	PP	Backstreet Boys	2000	-5	0.0	>25 s.	18	4
8	Livin' la Vida Loca		Ricky Martin	1999	-6.5	0.0	12	5	3
9	Need to Know		Marc Anthony	1999	-7	0.0	19	10	3
10	Razor Tongue		DJ Mendez	1999	-6	0.0	17 s.	9	4
11	I Got a Girl		Lou Bega	1999	-6.5	0.0	>25 s.	3	4
12	Let's Get Loud	PP	Jennifer Lopez	1999	-6	0.0	>25 s.	10	4
13	Smooth		Santana	1999	-7	0.0	20 s.	15	4
14	Oye Como Va	RM	Santana	1970 1999	-12	0.0	0	0	1
15	Avalon	RM	Roxy Music	1982 1999	-9	0.0	5	0	2
16	Believe		Cher	1998	-5.5	0.0	10	4	2
17	Miami		Will Smith	1997	-11	0.0	17	9	3
18	That Don't Impress...		Shania Twain	1998	-9	0.0	3	0	2
19	Vissa Har Det		Bo Kaspers Ork.	1998	-11	0.0	1	0	1
20	True Colors		Phil Collins	1998	-12	0.0	1	0	1
21	Block Rockin' Beats		Chemical Bros.	1997	-6	0.0	8	5	2
22	El Cuarte de Tula		Buena Vista SC	1997	-12	-0.2	0	0	1
23	Dimples		John Lee Hooker	1997	-11	0.0	0	0	1
24	Bla Bla Bla		Oestkyst Hustlers	1996	-9	0.0	3	0	2
25	Bob Yu Did Yu Job		Jimmy Cliff	1996	-12	0.0	6	1	2
26	Where It's At		Beck	1996	-10	0.0	1	0	1
27	Wannabe	PP	Spice Girls	1996	-8	0.0	5	0	2
28	The Only Thing		Bryan Adams	1996	-9	0.0	2	0	2
29	We'll be Together		Sting	1994	-12	-0.2	1	0	1
30	Off the Ground		Paul McCartney	1993	-12	0.0	1	0	1
31	I've Been to Memphis		Lyle Lovett	1992	-16	-0.9	0	0	1
32	Good Stuff	PP	B52's	1992	-12	0.0	5	0	2
33	Gloria's Eyes		B. Springsteen	1992	-11	0.0	0	0	1
34	Mysterious Ways		U2	1991	-11	-0.1	0	0	1
35	Something to Talk...		Bonnie Raitt	1991	-14	-0.9	0	0	1
36	Black or White	PP	Michael Jackson	1991	-11	-0.2	0	0	1
37	The End of the...		Don Henley	1989	-13	-2.2	0	0	1
38	Dirty Blvd		Lou Reed	1988	-14	-0.2	0	0	1
39	Nick of Time		Bonnie Raitt	1989	-17	-2.1	0	0	1
40	Living in America		James Brown	1986	-16	-2.6	0	0	1
41	Graceland		Paul Simon	1986	-16	-3.4	0	0	0
42	Two Tribes	PP	Frankie Goes...	1984	-6.5	-0.7	1	0	1
43	She Took Off My...		David Lindley	1981	-13	-1.9	0	0	1
44	Little Sister		Ry Cooder	1979	-22	-8.7	0	0	0

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- James Brown (1986): average at -16 dB, peak at -3.4 dBFS
- Back Street Boys (2000): average at -5 dB, peak at 0 dBFS

## 7.26. Loudness War: Listening

- The Roots: Ital (The Univesal Side) (Illadelph Halflife, 1996)
- The Roots: Guns are Drawn (The Tipping Point, 2004)

## 7.27. Reading: Horning

- Horning, S. S. 2002. “From Polka to Punk: Growth of an Independent Recording Studio, 1934-1977.” In *Music and Technology in the Twentieth Century*. H. Braun, ed. Baltimore: The Johns Hopkins University Press. 136-147.
- 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.

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21M.380 Music and Technology (Contemporary History and Aesthetics)  
Fall 2009

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