

## **Chapter 24. Meeting 24, Dithering and Mastering**

### **24.1. Announcements**

- Mix Report 2 due Wednesday 16 May (no extensions!)
- Track Sheet Logs: show me after class today or monday
- Subject evaluations!

### **24.2. Review Quiz 4**

- ?

### **24.3. Recording Session Review**

- From Meeting 17, Workshop: Recording Session 1  
Instrumentation: 5 singers, including soloist
  
- From Meeting 19, Workshop: Recording Session 2  
Instrumentation: piano and horn
  
- From Meeting 22, Workshop: Recording Session 4  
Instrumentation: gtr, bs, drum kit, 3 vocal, more

- From Meeting 23, Workshop: Recording Session 5

Instrumentation: 14 singers, 7 male, 7 female

## **24.4. History**

- Mastering was necessary due to limitation of mediums (records)
- A master specifically referred to an object used to make copies
- Contemporary mastering is really the preparation of a premaster

## **24.5. Motivation**

- Maximize dynamic range
- Sweeten, optimize, and make a mix gel for as many playback systems as possible
- An outside consultant on sonic quality and balance
- A means of competing for attention
- “Mastering is the art of compromise” (Katz 2002, p. 100)

## **24.6. Analog and Digital Mastering**

- Analog mastering is still very popular, but is very expensive
- Many desire to add analog warmth into digitally recorded and/or mixed music
- Digital is cheaper, more repeatable

## **24.7. Training Your Ears**

- Mastering takes experience
- Hearing masters on multiple systems is critical
- High-quality playback systems, and multiple playback systems, are nice, but not required

## 24.8. Metering

- Good, reliable digital meters are critical
- Need to look at peak and average levels levels, possibly with frequency-dependent weighting
- Example: Inspector: IXL Level
- Example: Level Meter (Logic): use two instances, one at Peak, another at RMS

## 24.9. Maximum Peak Levels

- Loudness is not determined by peak level; mastering is not normalization
- No samples in a mix or master should reach 0 dBFS
- Maximum master peak should never be greater than -0.2 dBFS
- Additional head room (-3 dBFS) may be valuable
- Amount of peak movement matters: stuck (pegged) meters are never good
- Peaks should be balanced between L/R channels

## 24.10. RMS

- RMS: root mean square, or the square root of the average of values (from within a window) squared
- Better than VU for evaluating loudness
- May or may not be weighted according to Fletcher Munson
- Mastered audio is generally in the range of -8 to -16 dB RMS

## 24.11. The Loudness War

- Mastering has increased overall loudness of recordings in recent decades
- Statistical Evidence from Nielsen, S. H. and T. Lund. 2003. "Overload in Signal Conversion." In *Proceedings of the AES 23rd International Conference*.

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

## **24.12. Loudness War: Waveforms and Listening**

- John Coltrane: My Favorite Things (1961)
- The Roots: Ital (The Univesal Side) (Illadelph Halflife, 1996)
- The Roots: Guns are Drawn (The Tipping Point, 2004)

## **24.13. Mastering Is Not (All) Evil**

- 2006: Hank Plank and the 2x4s: Planks of Grass: Shameful Me
- 2007: Various: RESONANCE: Steel Pan in the 21st Century: Ariza: phanopoeiac
- 2011: Peter Evans Quintet: Ghosts: Ghost
- 2012: Alexander Sigman: Nominal / Noumenal: Entartete
- 2010: Architeuthis Walks on Land: Natura Naturans: Pickup Track
- 2008: Various: SPECTRA: Guitar in the 21st century: Jandek: The World Stops

## 24.14. Basic Steps and Bits

- Mix from 16 or 24 bit sources without master-bus processing
- DAWs mix internally at high bit depths (32 or 64) to offer headroom
- Bounce to disc a 24 bit stereo mix
- Create a new session for 24 bit mastering
- Bounce to disc a 16 bit stereo mix

## 24.15. A Bit of Review

- Bits are discrete data
- 16 bit audio stores 65,536 amplitude positions for 96 dB dynamic range
- 24 bit audio stores 16,777,216 amplitude positions for 144 dB dynamic range
- Bit depth  $\times 6$  == dynamic range dB
- Internal DSP processing in DAW is at least 32 bit

## 24.16. Falling Between Bits

- Imagine 2 bit (using only 3 amplitude position) encoding ADC
- Input range is between -1 and 1 volt, encodes amplitude positions at -1, 0, and 1
- If a DC voltage enters at .35, signal will be encoded as zero, and all information is lost
- If a small amount of random samples (white noise with an amplitude of at least .25) is added to the input signal, some samples will be encoded at 0 and others as 1
- The average of many encoded samples will be .35

## 24.17. Dithering

- Adding noise to extend dynamic range downward; often most significant for sounds at bottom of dynamic range
- Exercises, toggles, or modulates lowest bits
- Dithering is always used when moving from a high bit depth to 16 bits

- Dithering should never be performed twice
- Without dither, truncation and poor dynamic range results
- Permits 16 bit audio to extend dynamic range below -96 dBFS; best dithering can result in a perceived dynamic range as great as 115 dB (near 19 bit resolution)

## 24.18. Dithering: Noise Shaping

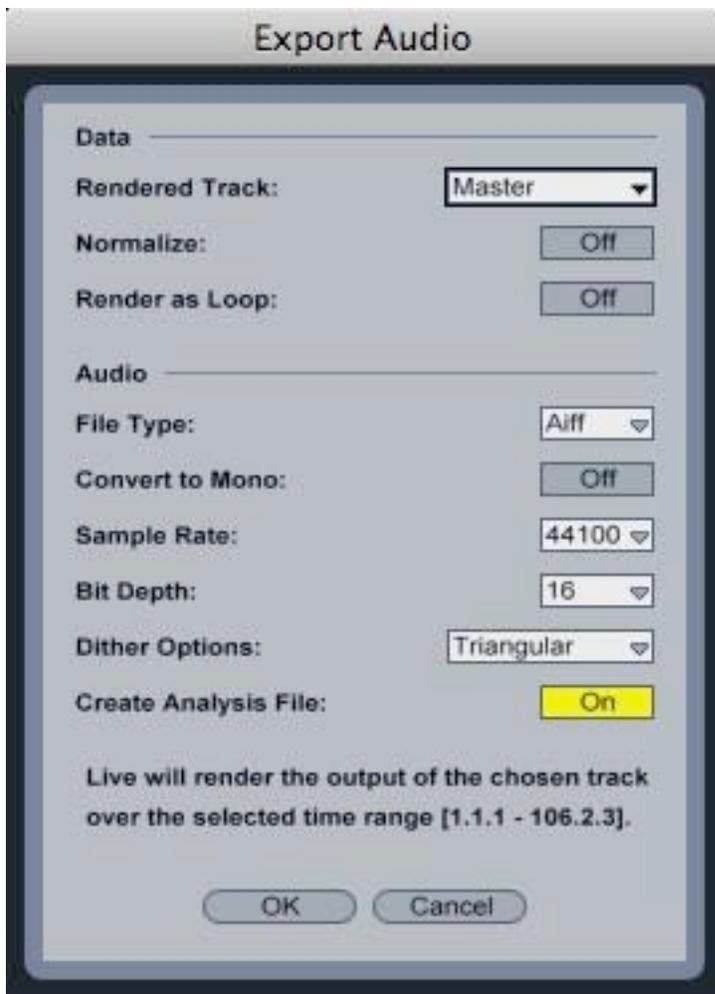
- EQ the spectrum of the applied noise to reduce perceptibility
- Avoids frequencies that are loud on Fletcher Munson (around 3 kHz)
- Different types of dithers use different noise shapes

## 24.19. Basic Steps and Bits

- Mix from 16 or 24 bit sources without master-bus processing
- Bounce to disc a 24 bit stereo mix *without* dither
- Create a new 24 bit session for mastering processing
- Bounce to disc a 16 bit stereo mix *with* dither and noiseshaping

## 24.20. Dithering Processors

- May be stand alone or coupled with other mastering dynamics processors (limiters and/or compressors)
- Main parameter is bit depth (output) and noise shaping parameters
- Numerous limiters have dithering included
- Be careful to not add dither twice
- Example: Sonnox Oxford Limiter Dither
- Example: Logic Bounce Dither options: Apgee UV22HR, Pow-r #3
- Example: Live Export Audio



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## 24.21. Mastering Setup: Monitor Usage and Calibration

- Listening on multiple monitors is essential in mastering
- 0 dB position of monitors should produce 83 dB SPL with pinknoise
- Pinknoise should output at -20 dBFS RMS
- 83 dB lands at best point in Fletcher Munson

# Fletcher-Munson Curves

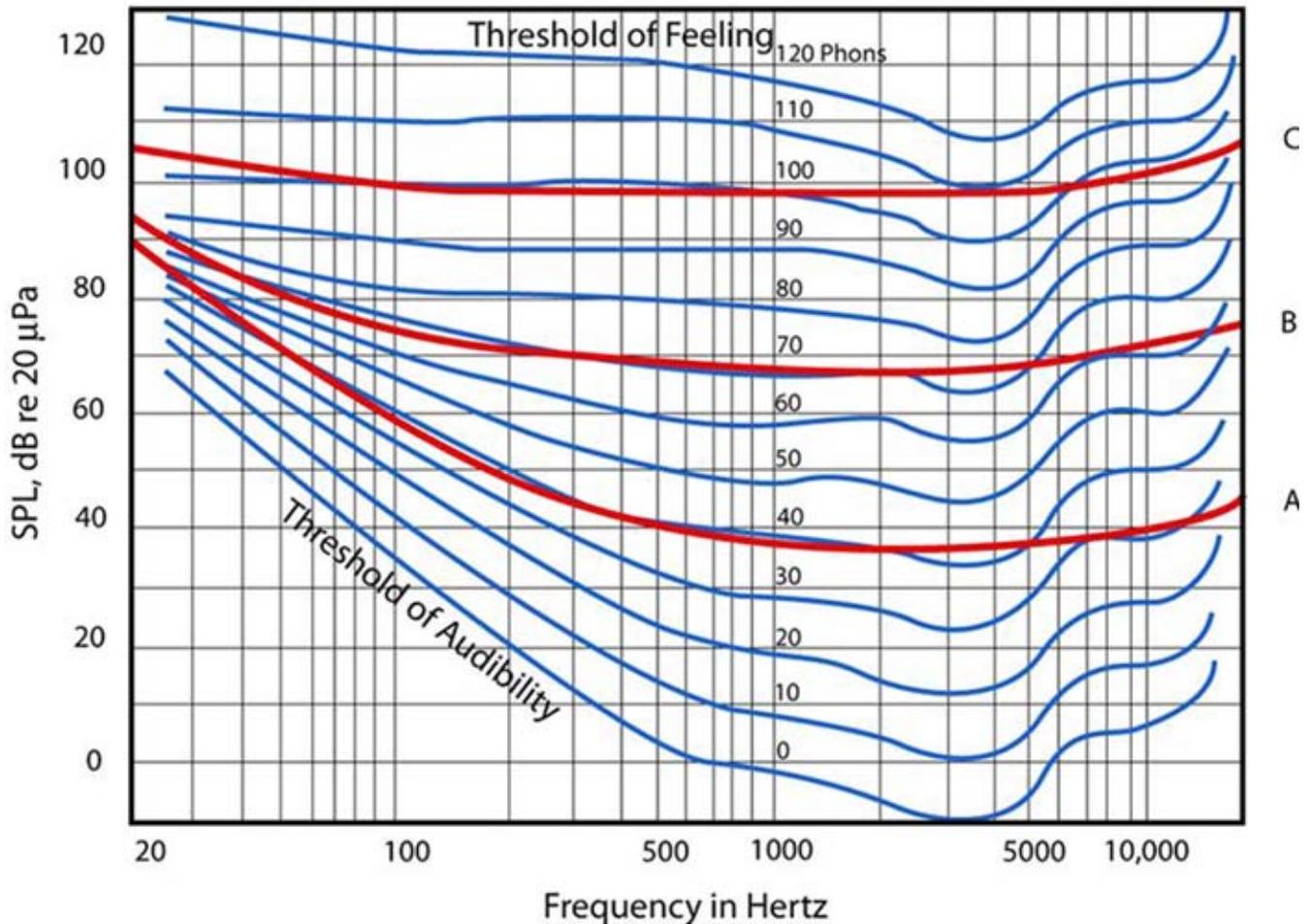


Image: "Fletcher-Munson Curves" from *Principles of Industrial Hygiene*. Available at: <http://ocw.jhsph.edu>. License CC BY-NC-SA, © Johns Hopkins Bloomberg School of Public Health.

## 24.22. Mastering Track Setup

- Create a source track and a master track
- Add mastering inserts to source track
- May have a duplicate clean source track for quick comparison
- Add metering and visualization plugins to master track

## 24.23. Mastering Processors

- Less is more and quality matters
- Limiters: peak limiters, brick wall limiters, mastering limiters
- Filters: parametric filters, linear phase filters, dynamic filters

- Dynamics: manual fade adjustments (macrodynamic manipulation), multi-band compressors/expanders/gates, leveling amplifiers
- Exciters, saturation processors, tube emulators, maximizers
- Noise reduction processors
- Time/phase adjustments, stereo optimization, mid-side adjustments
- There is no standard set of processors to employ: each mix is different

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