Audio
It's ½ of Audio-Video

When shooting a video, it's a common mistake to focus your attention on what the camera sees, and not what it hears. Audio is literally ½ of the content, and poor audio will quickly detract from the video. This course will provide some tips on recording better audio, cleaning up poor audio, and sweetening the sound.

Decibels and Clipping Levels

- Decibels (db) refers to a power level. Many types of signals are measured in decibels, but they don’t refer to the same thing.
- For sound power, 0 db a is the threshold of human hearing. Anything lower can't be hear by most people. For digital processing 0 db FS represents the maximum wattage that can be expressed with the number of available bits (e.g. if using 16 bits then the max. value for a signal is 65535 (absolute); anything louder is clamped to that value as you don't have any more bits).

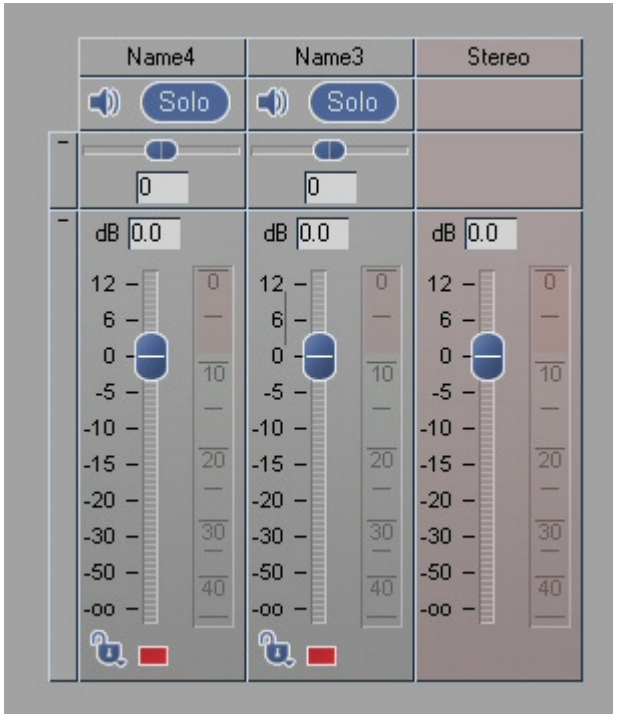
Decibels and Clipping levels (cont).

- Analog signals measured in db a or db c. This is the power level of an audio signal with frequencies outside the range of human hearing filtered out.
- Digital signals are measured in db FS (Full Scale). A digital measurement has a maximum value M depending on the number of bits used. If the actual power measurement is p, the dB FS value displayed is $20 \cdot \log10(p/M)$ dB FS. Since p cannot exceed M, this reading is always negative.

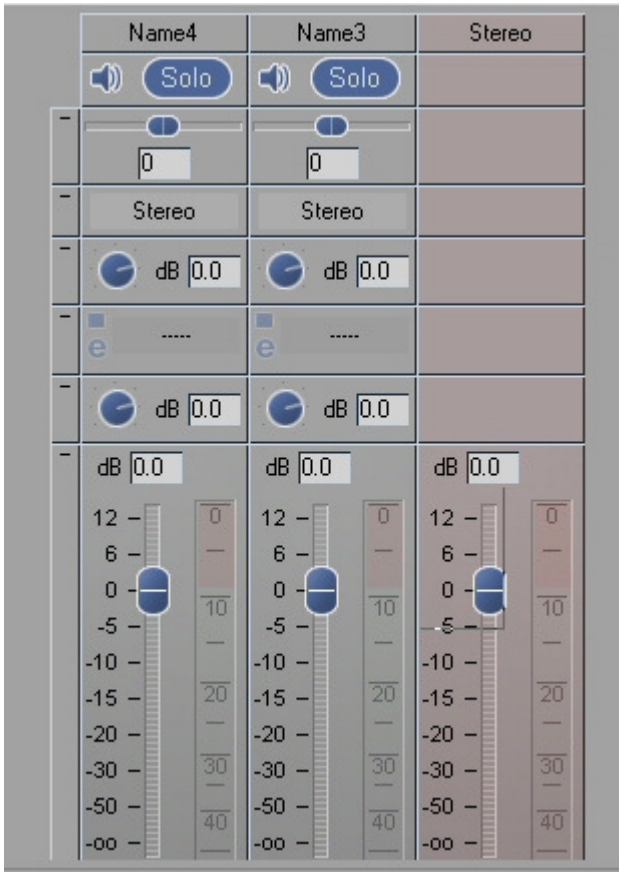
Avid Liquid Audio Editor

- Audio editor consists of the Mixer and Output Mapping.
- Mixer controls clip and track volume, panning, and effects.
  - Default view shows Clip Level and Panning controls only.
  - Additional controls displayed by selecting them in the Audio Editor Settings tab.
- Output Mapping routes audio signals from the timeline to the output device or file.

Audio Mixer



Default display



Expanded display

Audio Mixer

Track Name
Mute/Solo

Track Panning

Output Bus Type

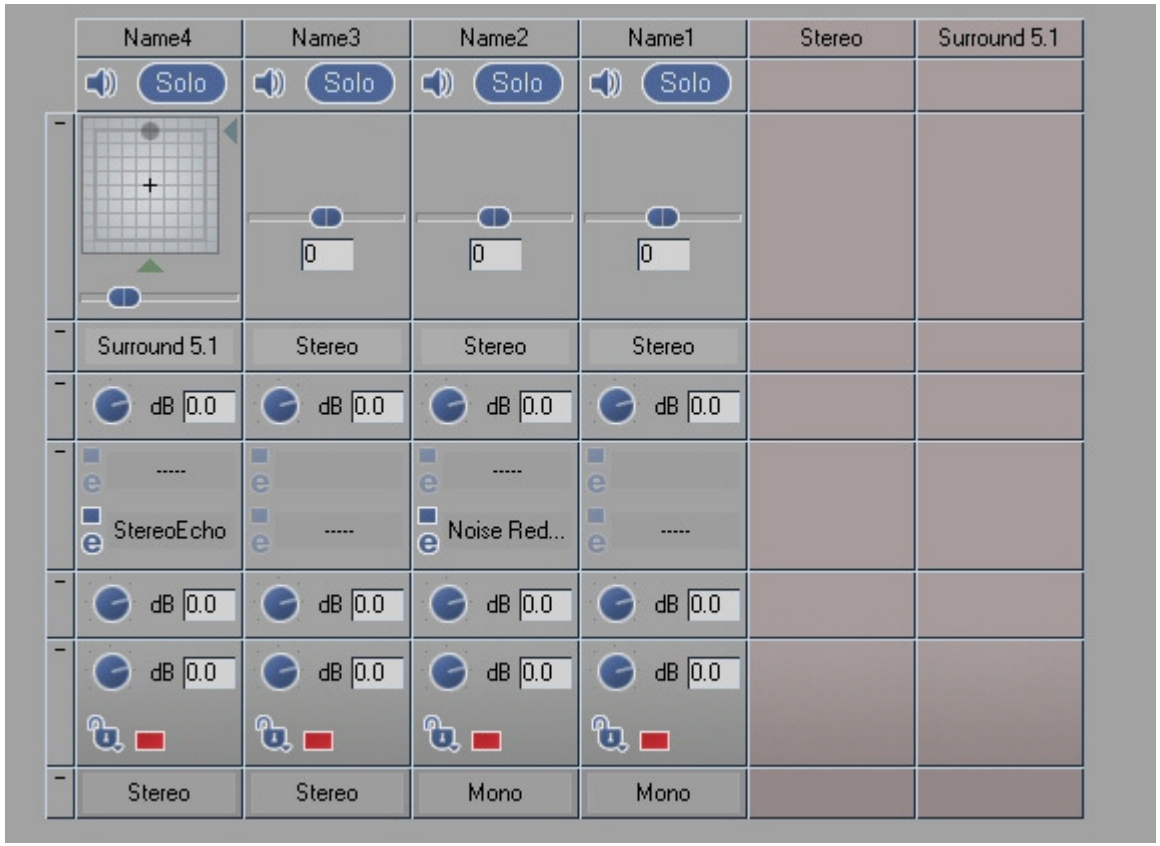
Output Level

Track Effects

Source Track Level

Clip Level

Track Type



Mixer with all controls displayed

Audio Mixer

- Based on concept of conventional analog or digital mixing board.
- Audio signals (clips and tracks) are routed through one or or busses to an output device or file.
- A bus is a virtual or physical device.
  - One or more signals may be grouped through a bus
  - Busses may have own controls
  - Busses may be routed through other busses
- Signals proceed from bottom to top through the busses and out to the file or device.

Audio Mixer Signal Path

- Track Type
  - Identifies the type of the track. Can be Mono, Stereo, Classic (4 channels) or Surround (6 channels, Liquid 7.0 or later).
  - Number of level meters shown is dependent on track type (mono shows 1 level meter, stereo 2, etc.)
  - Affects downmix to final signal (a stereo source will be downmixed to a mono signal for a mono output device).

Audio Mixer Signal Path

- Clip Panning (not shown on figures)
  - Only displayed if using Classic Routing.
  - Provides keyframed clip-level panning control.
  - Show Panning keyframes in the clips by right-clicking on loudspeaker icon and choosing Show Track Output Panning
  - Can change keyframes on the timeline or via the Clip Panning control

Audio Mixer Signal Path

- Clip Level
  - Provide keyframed clip volume level
  - Levels are relative. Changing control to +3db raises level 3 decibels; it does not set the level to 3 decibels.
  - Automation (small red square)
    - Selecting plays back track and allows live editing of volume levels
  - Group Tracks (padlock icon)
    - Lock tracks of the same color together.

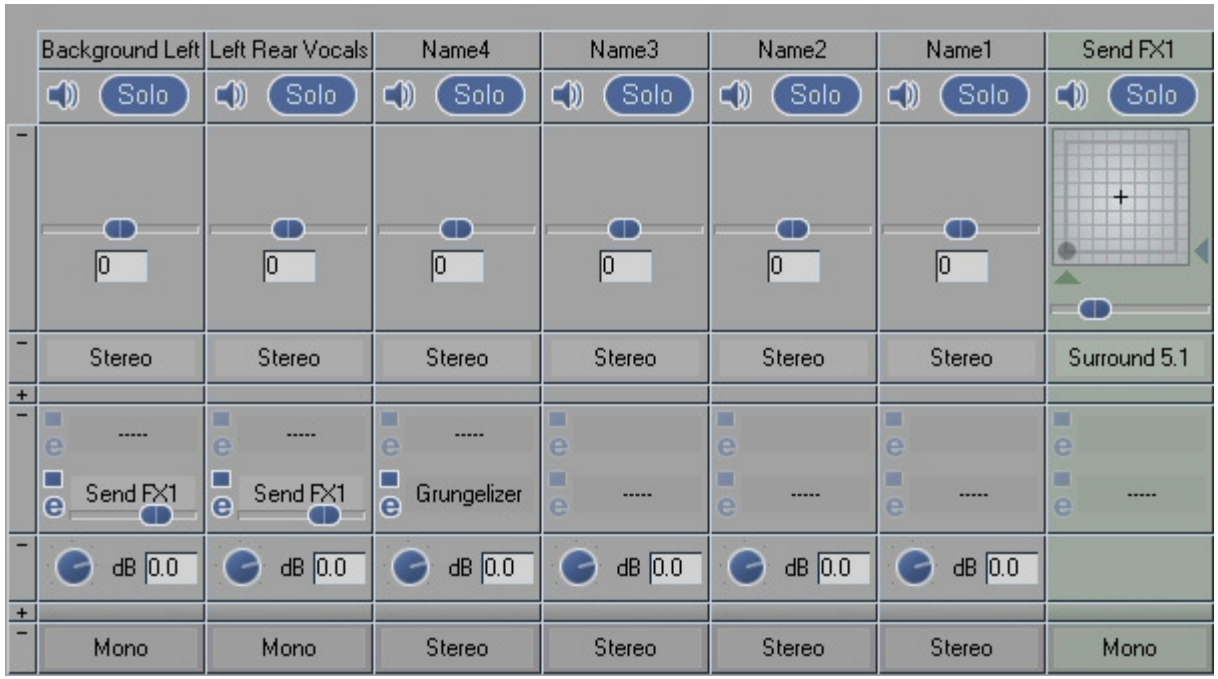
Mixer Path (cont.)

- Source Track Level (Input Level)
  - Non-keyframed track volume level
  - Raising Clip Level +3db and then Input Level +3db results in signal at +6db.

Audio Mixer Signal Path

- Track Effects
  - Applies audio filters to a track. This is the same as dragging an audio filter from the library to the track header.
  - Can also specify a Send bus
    - Send busses are a way of combining multiple signals into a single source.
  - Send busses may have own effects and/or send to other Send busses.
  - Can add multiple effects or send busses
    - Effects or busses processed bottom to top.

Send Bus Example



Mono tracks from Background Left and Left Rear are combined and routed to bus Send FX1(rear left Surround channel).

Signal Path (cont.)

- Output Level
  - Non-keyframed control to modify volume level after process through the Track Effects.
- Output Bus Type
  - Determines logical output routing.
    - 3 bus types; Stereo, Classic, and Surround
  - All tracks are routed to appropriate bus and combined to master signal (so 3 stereo tracks would be combined into a single stereo track on the stereo output bus).
  - Logical busses mapped to physical busses in Output Mapping.

Signal Path (cont.)

- Track Panning
  - Non-keyframed panning control.
  - For Mono controls the balance left/right.
  - For Stereo controls panning left/right.
  - For 5.1 can pan left/right and front/back to specific position in relation to the center of the room.
- Mute and Solo
  - Mute current track. Output is not routed to an output bus.
  - Solo current track. Disables playback for all other tracks.

Output Mapping (Routing)

- Maps the logical bus types (Stereo, Classic, Surround) to actual output device or file.
- Number of output busses dependent on devices attached.
  - Sound Card
  - IEEE1394
  - Pro Break Out Box
- Internal busses always present.
  - Fuse Export
  - Audio Scrub
  - DirectSound

Mapping (cont.)

- Can map individual channels (e.g. can map left stereo input signal to right stereo output signal if desired).
- When using Classic routing, odd channels (A1/A3) mapped to left, and even channels (A2/A4) mapped to right.
- Common error
  - When capturing 4 tracks from a stereo source, A1 and A3 are identical as are A2 and A4. The default stereo output mapping will combine all tracks into final signal at twice expected amplitude, resulting in clipping.

Output Mapping Example

Typical routing setup. Notice in Surround 5.1 logical bus that the Left channel maps to Fuse/Export Left and Front Left channels while the LFE channel maps to the Left, Right and LFE Fuse/Export channel.

Common Questions about Mapping

- *"I have a mono input source and a stereo bus output type. Which channel does it route to?"*
  - The panning control determines this. If set to center, the signal is split to 50% left and 50% right.
- *"Does it work the same for 5.1 surround?"*
  - Yes. The 5.1 bus expects mono channel tracks. If you specify a stereo track, it's downmixed to mono first.
- *"Does a Surround track type get downmixed to Mono when the output bus is Surround 5.1, and if so how?"*
  - Good question. (Bad answer!)

Creating Surround 5.1 Audio

- Creating a 5.1 channel audio requires 5 discreet channels of audio. The .1 (Low Frequency or LFE) channel is automatically created from the other 5.
- The rear channels are often added as Foley sounds or artificially faded to the rear.
- If shooting 5.1 channel audio live, use 5 (or more) microphones in approximately the same position as the desired output effect.

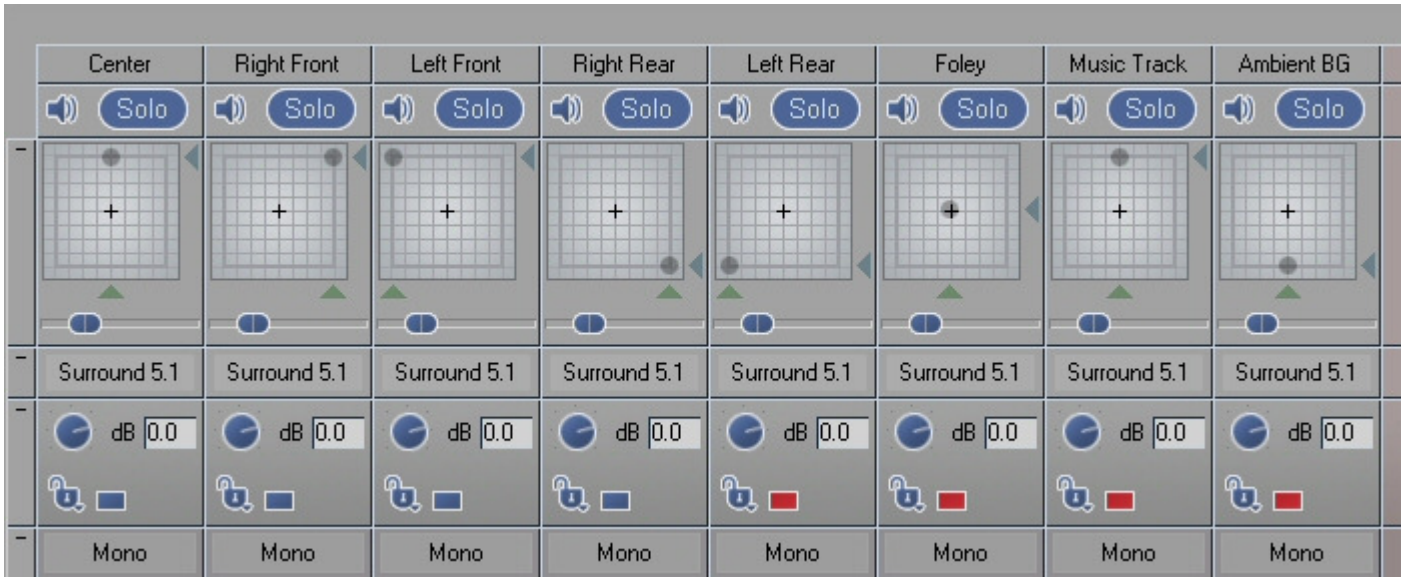
Surround (cont.)

- Example:
  - For a live music group performance, you may want several microphones on the band vocals for left, center, and right, and crowd microphones left front and rear and right front and rear (9 – 10 microphones). In post, fade between front crowd and band mic's to accentuate being "in the crowd".

Surround (cont.)

- To create the surround track in Liquid, add a separate audio track per channel (microphone) and for musical tracks and special effects.
- While you can add just 5 tracks (Center, LF, RF, LR, RR) and place clips on appropriate track, it's easier to manipulate all sources separately and map to proper output channel.

Surround Mapping Example



- Typical Surround Sound setup. Notice that Foley is set dead center. This will be keyframed during edit. There will normally be one Foley track for each Foley sound in a scene.

Creating Surround 5.1 Audio (cont.)

- For the previous example, the default output mapping will produce the desired result.
- To fuse to a Stereo downmix you should plan on reducing the volume levels to prevent clipping.
- Surround 5.1 clips can be played via a capable sound device, exported as individual sound files, or exported as a Dolby Digital™ AC3 file when authoring a DVD.
- There is no Fuse to AC3 in Avid Liquid 7.0 SP1.

Using VST Plug-ins

- VST (Virtual Studio Technology) is a standard for audio plug-ins created by Steinberg Audio.
- All audio effects in Liquid are VST Plug-ins. VST Plug-ins cannot be key framed. Built-in VST controls may be key framed.
- Plug-ins may have their own control interface.
- To add a plug-in, drop it into the Avid Liquid VST directory (e.g. c:\Program Files\Avid\Avid Liquid 7\PlugIns\VST).

VST Banks and Programs

- A VST Program is a VST effect with preset parameters. You can customize a VST control and save it as a program.
- A Bank is a collection of programs. The list of available VST effects is a VST Bank.
- VST programs can be applied to a clip or an entire track.

Getting VSTs

- VSTs, from freeware to commercial, are widely available on the World Wide Web.
- Some freeware VST sites
  - VSTCentral.com
  - www.ctgmusic.com/community-articles.php?type=2&id=9
  - www.futureproducers.com/forums/showthread/threadid/94385

  Note: I make no claims about the usefulness or trustworthiness of any of these sites or the VSTs. This is just an example of what's out there.

Noise Reduction

- Best form of Noise Reduction is not recording noise!
- Noise reduction often distorts resulting audio.
  - Fuzziness
  - Flanging (tinny echoing)
- If you have to use Noise Reduction, consider Audio Dialog Replacement (ADR), otherwise known a Dubbing.

Noise Reduction Filter

- Added with Avid Liquid 7
  - Basic noise reduction filter
  - Limited controls (Amount, Fine Tuning)
  - Reasonably good at removing wind and low frequency rumbles
  - Cannot specify sound print; limited usefulness

3rd Party NR Filters

- Possibly expensive but worthwhile acquisition.
  - Many allow you to specify a noise print and remove just that noise from a given audio source.
  - More control over distortion and flanging.
- Tip: When reducing noise using a noiseprint based tool, run multiple passes using a small amount of reduction instead of 1 pass with large amounts. This reduces flanging and distortion.

Notch Filters

- Removes a specific frequency (or range of frequencies) from a clip.
- Can be performed from specific control or via an Equalizer control.
- Easily remove constant hum (e.g. 60hz electrical hum from overhead fluorescent lamps) or camera noise.
- Depending on specific equalizer may require adding multiple times to cover all required frequencies.

Equalizers

- Liquid 7 has three equalizers built-in; Real-Time, Classic, and VST Plug-In
- RT Clip Effects->Audio->Equalizer
  - 10-band graphic EQ. Bands are fixed at specific frequencies.
  - Has six presets
    - Flat: Set all values to zero
    - Clear:
    - Heavy: Boost bass and high, lower midrange
    - Soft: Lower bass and high
    - Telephone: Mimic audio characteristics of a telephone
    - Vocal: Boosts frequencies used by the human voice

Equalizers (cont.)

- Classic Clip FX->Audio->Equalizer
  - 3-band Parametric EQ. Bands are adjustable.
  - Midrange band has Q (bandwidth) control.
    Bandwidth = Center Frequency / Q
    Larger values of Q result in narrower bandwidth.
  - Can stack multiple filters together to build more complex equalizer effect.
- RT Clip Effects->Audio->LiquidEQ
  - 4-band Parametric EQ. Bands are adjustable.
  - Frequency response determined by shape of frequency curve on a graph.
  - **No Documentation!**

LiquidEQ

Program Name

Graphic Display

Enable Button

Attenuation Level

Rotary control

Center Frequency

Bandwidth (Q)

LiquidEQ showing notch filter from 850hz – 1041hz

LiquidEQ (cont.)

- Bandwidth (Q)
  - Lower values result in wider bandwidth (shallower shaped curves).
  - Lo control
    - At lowest level operates as Low Shelf filter. Frequencies lower than this value are unaffected.
    - At highest level operates as High Pass filter. All frequencies lower than this value are affected.
  - High control
    - Operates as High Shelf / Low Pass filter (opposite of Low control)

LiquidEQ (cont.)

- Center Frequency
  - Frequency around which bandwidth controls. Can be set by clicking on display value, operating outer ring of rotary control, or dragging the marker in the graphic display left/right.
- Attenuation Level
  - Change of attenuation (relative volume) in decibels. Can bet set by clicking on display value or operating inner dial of rotary control.
- Enable button
  - Activates range control. If disabled control point not available in graphic display.

LiquidEQ (cont.)

- Graphic Display
  - Displays graphic view of frequency curves and control points.
- Program Name
  - VST Program name. Click to alter name.
  - Can save up to 14 programs in a VST Bank.
  - Load VST Bank to reload programs.

Other Audio Filters

- Maximizer
  - Combination of dynamic compressor and limiter
  - Normalizes audio to achieve maximum output level without exceeding clipping level.
- Leveler
  - Manual compressor. Attempts to even out differences in volume level.
  - Must specify target volume.

Other Audio Filters (cont.)

- Grungelizer
  - Adds noise and crackle to simulate old radio recordings and vinyl records.
- Karaoke
  - Attempts to remove vocals. Works by assuming vocals carried equally on left/right channels and subtracting channels will remove. Only works well for material where vocals are centered in the audio image.
- StereoSpread
  - Spread the “distance” between the left/right signal. Higher levels cause audio to appear less centered.

Recording the Audio

- When filming, always monitor the sound
  - Wear full enclosure headphones.
  - If using multiple cameras and microphones, monitor each one separately when possible.
- Don’t depend on automatic volume control
  - Automatic controls try to maintain an average level.
  - Often will be set too low for recording quieter sounds
  - May be a good choice in environments with fast changing, unpredictable sound level.

Choosing a Microphone

- Directional Microphones
  - Pick up sounds predominantly from straight in front
  - Highly sensitive
  - May be more susceptible to wind noise and pops
  - May cause distortion if too close to sound source
- Omni Directional Microphones
  - Pick up sounds from all around the microphone
  - May be designed to prefer a direction
  - Better than Directional for close, hand-held work

Condenser vs. Dynamic

- Dynamic Microphones
  - Require no additional power supply
  - Inexpensive
  - Limited response range
- Condenser Microphones
  - Require power to operate (often referred to as Phantom Power)
  - Much more sensitive than Dynamic Mic.
  - Wide response range
  - Expensive to very expensive
  - What the Pro's use

General Mic. Types

- Hand-held
  - Commonly use for Electronic News Gathering (ENG)
  - Quickly and easily face towards sound source
  - Intrusive (as in “In your face”)
- Boom
  - Most often used on film set
  - Often used for ENG
  - Requires a grip to hold and position the mic.

General Mic. Types (cont.)

- Lapel
  - Commonly used wherever a large mic. is unwanted.
  - Unobtrusive, but if wireless may require large transmitter to be placed somewhere on body.
  - Single user pickup only. Must have one per sound source (generally a person).

Wireless Microphones

- Wireless solutions can be very expensive
  - Inexpensive wireless prone to cross-talk, noise, poor range, poor response.
  - May need multiple channels to avoid cross-talk with nearby electronic equipment.
  - Must use multiple channels for multiple mic's.
- Best solution for "on the go" productions

Wired Microphones

- Wired Microphones may be balanced or unbalanced. This refers to what kind of wiring is used.
- Unbalanced
  - Generally a 2-wire cable, with or without shielding
  - Good for short runs
  - Easily picks up noise from nearby electronic and and electrical equipment.

Wired Microphones (cont.)

- Balanced
  - 3-wire cable with shielding. Often uses XLR connector but may use a straight jack instead.
  - Good for long runs
  - Design actively cancels noise from external source.

XLR Jack

Balanced Straight Jack

Filming on Location

- Wind Noise
  - Most common source of interference.
  - Electronic wind noise filters may cause flanging or other unwanted modification to all recorded sounds.
  - Should use a foam or fur wind filter.
  - Can also use a large (3’ x 3’) board on the windward side of the microphone to block the wind.

Filming on Location (cont.)

- Unwanted ambient noise
  - Everything you don't want to hear (ambulance siren, kids yelling, cars going by, etc.)
  - When possible, use a hand-held, boom-held, or lapel microphone. Getting a pickup microphone close to your subject will cut down on ambient noise.
  - If you can't use a close microphone, use a good quality highly directional shotgun microphone.

Sweetening the Sound

The average camera microphone generally falls into the category of an inexpensive dynamic microphone bolted to a box with moving parts. The result is audio with poor bass performance, distorted highs, low sensitivity, and a constant audio hum from the camera motors and spinning video drum.

Sweetening the Sound (cont.)

- When possible, use external microphone. If connected to camera, use rubber isolation bands to minimize noise communicated via the camera body.
- When possible, use condenser microphone. Some condenser microphones have internal batteries. May need to add separate Break Out Box with XLR connectors and/or phantom power.
  - Beachtek
  - XLR Pro

Sweetening the Sound (cont.)

- If using an inexpensive microphone, boost the midrange frequencies and lower the bass and high range frequencies.
- Pay close attention to –9db mark on analog peak volume displays. Digital signals often peak above 0db clipping level before analog display can respond.
- If using on-camera stereo microphone, add StereoSpread filter and accentuate the spatial difference.

Straight Cuts vs. Split Cuts

- Straight Cut
  - Audio cuts where video cuts.
  - Simplest of all transitions.
- Split Cut
  - L-cut: Audio continues after the video cuts.
  - J-cut: Audio cuts while the video continues.

Split Cuts

- Why use Split Cuts?
  - Can cover difficult or awkward transition point in the video.
  - L-cuts heighten sense of continuity.
    - Cutting from John to Jane while John is talking gives audience a chance to see Jane's reaction to the conversation.
    - Cutting from narrator talking about the mountain view to the mountain view is more interesting than watching the narrator talk and then panning the mountain with no narration.
  - J-cuts heighten sense of anticipation
    - After John issues ultimatum to Jane we see John's reaction to Jane laughing in his face. The audience anticipates a cut to Jane to see her full response.

Creating Split Edits

- Must unlink audio and video tracks
  - Right-click on clip in the timeline and choose Item Link->Unlink Items.
  - Audio and video tracks can now be manipulated separately.
- Use Edit Tool (razor blade) to add a cut.
  - Remember that Edit Tool cuts all active tracks in the timeline. Disable all tracks except track(s) to be cut.
- Drag handles or use Trim Editor to alter length of audio or video clip as necessary.