

Mic Techniques

The Sound Engineer's Voodoo

What are the considerations?

- Application
- Mics available
- Environment
- Desired Result

Types of Mics

-Dynamic: More durable, less transient response, passive (no phantom power required)

-Condenser: More fragile, greater transient response, active (phantom power required)

-Ribbon: Very Fragile, great transient response, phantom power will kill it!

-Piezo: Uses a substance that produces voltage when subjected to pressure. Usually found in under-bridge acoustic guitar pickups as an alternative to magnetic coils.

-Many other kinds: Fiber Optical, Laser, MEMS, etc.

Why Dynamic? Why Condenser? Ribbon?! Piezo?!

-Pros/Cons of Dynamic:

- Pros: Durable, resistant to high SPL, "warmer" sound due to lesser transient response, no phantom power required
- Cons: Lesser transient response, warm ~ muddy

-Pros/Cons of Condenser:

- Pros: Greater transient response resulting in a "sharper" or "crisper" sound (this is especially useful for acoustic guitar and drums)
- Cons: Fragile, sensitive to high SPL, requires phantom power

-Ribbon Mics:

- Pros: Very good transient response with a warm, old-fashioned sound. Very good for certain instruments like violin.
- Cons: Very fragile, phantom power will probably kill it

-**Piezoelectric Mics:** Usually found in contact applications (ie miking a hand drum), and in acoustic guitar pickups.

Mic characteristics to consider

-Directionality: A microphone's sensitivity to sound depending on the direction from which the sound arrives.

- Different polarity patterns, and their respective uses
 - Omnidirectional
 - Unidirectional: Cardioid, Super/Hyper Cardioid
 - Bidirectional (figure 8)

-Utilize polarity patterns to:

- Reject ambient noise
- Allow yourself greater flexibility in distance from sound source
- Avoid off-axis coloration (muddying) of your source

Proximity Effect

-Unidirectional microphones' bass response increases as the mic gets closer to the sound source. Within 1 foot, this effect becomes very noticeable. Be aware of this, and correct the problem by rolling off the low frequencies at the mixer, or at the mic if it has a low-cut switch. You can also use an omnidirectional microphone which does not exhibit this effect.

Gain-before-feedback

-Which type of mic will allow the greatest amount of gain before feeding back?

- Unidirectional because of their focused pickup pattern.
- Preferred in most situations.

Direct Sound/Ambient Sound

In most environments, there will be some amount of ambient sound. This sound is at an even level throughout the room due to having been reflected many times.

The direct sound from an instrument or some other source falls off in intensity as it travels away from the source. The change in level can be measured with the inverse square law. This says the level change is inversely proportional to the square of the distance change. This works out to a 6dB loss when the distance from the source is doubled. Likewise, a halving of the distance to the source results in a 6 dB gain.

-The distance at which the ambient sound is equal to the direct sound is called the Critical Distance. Beyond this distance, sound quality will be very poor.

NAG vs PAG

Needed Acoustic Gain: The level of amplification that a sound system needs to ensure that the listeners farthest away from the sound source hear it as if they were sitting closest, and hearing it directly.

Potential Acoustic Gain: The maximum amplification that a sound system can provide. This is determined ultimately by the limitations of gain-before-feedback inherent in the system.

To provide sufficient reinforcement, a system's PAG must be greater than or equal to the NAG. To maximize PAG follow these general guidelines:

- 1) Place the microphone as close to the sound source as is practical.
- 2) Place the microphone as far away from the loudspeaker as is practical.
- 3) Place the loudspeaker as close to the audience as is practical.
- 4) Keep the number of microphones to a minimum.

Applications

What type of music is it? What does the band consist of? What type of venue/crowd is it? What gear is available? What sound personnel is there, if any? How much time is available for setup? What environmental concerns are there?

-Indoor Live Sound: What is the size/shape of the room? What loudspeakers are there, and where are they positioned? What do you need to mic? What should you mic? What overall loudness level is adequate/desired?

-Outdoor Live Sound: Same as indoor live sound, but instead of room shape/size considerations, weather conditions must be taken into account.

-Studio Recording: A different beast. The same acoustical principles obviously apply, but there are many key differences, with important consequences for the sound engineer.

Environment

How is sound altered by its environment?

- Reflection
- Absorption
- Diffraction
- Refraction

-Reflection: A sound wave will be reflected by an object if the object is as large or larger than the wavelength of the sound. Because low frequencies have long wavelengths, they can only be reflected by large objects. High frequencies will be reflected by even very small objects.

-Reflection can cause: echo, reverberation, and standing waves

-Absorption: Certain materials will absorb sound instead of reflecting it. Things like carpet and acoustic foam pads will absorb high frequencies. Things like drapes and bass-traps will capture lows. Humans wearing clothes also make great absorbers of mid to high frequencies! Whether or not the audience is present will have a significant effect on how a room sounds.

-Diffraction: The ability of sound waves to bend around objects that are not large as its wavelength. Low frequencies can bend around many more objects than high frequencies, and thus are more omnidirectional. This is why it is harder to get good directionality out of subwoofers than it is tweeters.

-Refraction: Sound waves will bend if they pass through a density difference in a medium. This primarily happens outdoors, with temperature and humidity fluctuations.

Phase Interference

-Two mics picking up a sound source at different distances will combine (in the mixer) out of phase, and result in a new, degraded signal. This effect is known as comb-filtering due to the dips and peaks in the new signal that resemble teeth of a comb. The location and degree of these dips and peaks depends on the degree of phase shift between the signals.

-Comb filtering also occurs when a single microphone picks up sound directly from a source, as well as a delayed, reflected version of the same sound. Then the location and degree of filtering is dependent on the distance between the microphone and the source of the reflection.

The 3 to 1 rule

-When using multiple microphones, place them at least 3 times as far from each other as they are from their intended sources. This will ensure that the effects of comb filtering are minimized since the duplicate signal each mic picks up will be reduced by at least 10 dB.

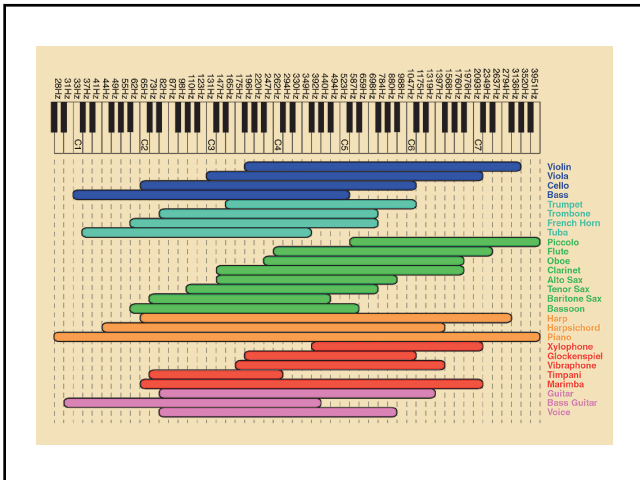
-This is based on omnidirectional microphones, and can be relaxed if using unidirectional models, but it should still be regarded as a good general rule.

Instrument Considerations

- Frequency Output
 - Fundamental Frequency
 - Harmonic Frequencies

-A microphone that evenly captures the full range of an instrument's frequency output will reproduce the most accurate and natural representation of that sound.

-A microphone that captures an instrument's frequency output unevenly, or is not able to capture it fully, will change the sound of the instrument, which may or may not be a good thing.



-Directional Output

-An instrument radiates a different timbre in every direction. In addition, each part of the instrument produces a different timbre. Usually, it is best to listen to an instrument at a distance of at least 2 or 3 feet so that the different parts of the instrument add to a more pleasing sound. Some instruments have a "sweet spot" directionally, and will sound best listened to from that angle.

-In live sound reinforcement, it is usually not possible to place a mic very far away from an instrument. Thus, when placing an instrument very near to a source, experiment with moving the mic around. Slight changes can have a significant effect on the tonal quality.

Dynamic Range-The range of an instrument's volume, from softest to loudest, measured in decibels.

- Determines maximum input to microphone, which will affect whether to choose a dynamic or condenser model.

- The maximum volume of the overall sound system is often dependent on the maximum gain-before-feedback of the softest instrument.

Desired Result

- There is no one "right" way to mic something. Whatever sounds right for the occasion is right, and that is largely a matter of personal taste. Experiment with different mics and placement techniques to achieve the sound you want, while remembering the basic acoustic principles we have discussed, as well as these guidelines:

- Get the source sounding good before you mic it.

- Tailor your microphone's frequency response to the frequency output of the instrument is possible, and filter out any frequencies lower than the fundamental frequency of the instrument.

- Plug one ear and move around the source while listening with your open ear. Find a spot that sounds good and start your placement there. Don't do this with extremely loud sources like guitar amps.

- Microphones placed closer to a source will have a better ratio of direct signal to ambient sound. However, mics placed too close may color the tone undesirably, and the proximity effect is almost always a concern with unidirectional mics.

- Use only as many mics as needed. Remember that adding mics means more ambient noise, increased risk of comb filtering, and turning down your overall volume to prevent feedback.

Common Problems

- Pop (breath sounds from letters P, T, D):

- Place the mic off axis from the mouth

- Place the mic closer than or farther than 3 inches from the mouth, which is the worse distance for this effect

- Use an omnidirectional mic

- Use a pop-filter

- Stand thumps and Handling Noise:

- Use an accessory or internal shock mount

- Use an omnidirectional mic

Stereo Techniques

3 Methods:

- Panning:
- Space Miking
- Coincident Miking

Tips for specific instruments

- Vocals
- Choral Groups
- Acoustic Guitar
- Violin
- Cello
- Mandolin
- Acoustic stand-up bass