Timbre Modifying DSP Effects

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Advanced Mixed Music Composition
Considerations Regarding Timbre Modifying Effects

- Less frequently used

**Figure 1. Numbers of works using different technology types.**

Survey of 353 works from various publishers; works date from 1953 to 2003.

Considerations Regarding Timbre Modifying Effects (cont.)

- Physical vibrations of an object are being processed
  → high degree of source bonding
- Closer to designing a new instrument
- Much more sensitive to differences in the input signal
- Requires more time with the performer to get the sound as wanted
Two Important Technical Issues Regarding Timbre Modifying Effects

• Latency

• Risk of Audio Feedback
Latency

• What is it?
Latency is the time delay between the entry and exit of an audio signal in a system. A range between 5ms to 11ms is often quoted as being the maximum acceptable amount of latency.

• In a computer system, what are the factors that contribute to latency?

\[
\text{Latency} = \sim 0.5\text{ms} + \frac{(\text{I/O Buffer Size} / \text{Sampling Rate}) \times 2}{2} + \frac{(\text{Buffer Size} / \text{Sampling Rate}) \times n}{n}
\]

Where \( n \) is the number of buffers required for processing.
Audio Feedback

• What is it?
Feedback is the sound produced when a signal which travels in a continuous loop in an audio system.

• What are the factors that contribute to feedback?
  - Spectral characteristics of the input (voice, instruments, ambient noise, etc.)
  - Room resonant frequencies
  - Frequency response of microphone
  - Frequency response of other audio components in the system (i.e., Loudspeakers, type of processing, etc.)
  - Distance of the source to the loudspeakers

• Why should we care?
Because it sounds terrible (when out of context) and can be dangerous if very loud, and…
because, in a concert situation, nothing says “you don’t know what you’re doing” like feedback!
Audio Feedback (cont.)

• With timbre modifying signal processing, feedback is especially susceptible since we are trying to mask the live sound of the input signal.

• How do we solve this?
Must maximize the amount of direct sound coming into the input.
  - This means getting the mic as close as possible to the source.
  - Low sensitivity mics (i.e., dynamic, or low-sens condenser) are very good for this, since they won’t overload as easily.

Move the source far from the speakers (not always possible)

You can transpose the input before reaching the processing
  - However, this will change the sound of the processing significantly.
Type of Timbre Modifying Effects

Harmonizer
• Can be seen as a timber modifying in that it can be used to create multiphonics or beating.
Example: Matalon, *Trace V*, for solo clarinet and live electronics

Ring and Frequency Shifting
• Very successful live; much like harmonizer there’s no center frequency, so little feedback risks
• Probably why one of the most used effect in concert music settings
Example: Stockhausen, *Mantra*, for 2 pianos and rings modulators

Filtering
• Probably most used processing effect (sound recording, etc.)
• Heard all the time in the sound files or tape parts of mixed pieces
• Seldom used successfully in live situations because prone to feedback
Example: Gervasoni, *Whisper Not*, for Viola and live electronics
Type of Timbre Modifying Effects (cont.)

**Distortion**
- Often heard in pop, but not often in concert settings
- Requires a lot of gain, thus very prone to feedback
Examples: -Romitelli, *Amok koma*, for chamber ensemble and live electronics
  -Peter Evans and Nate Wooley, *LXIX*, for two trumpets and guitar effects

**Cross Synthesis**
- Window time can be a problem with real-time applications, adds to latency
Example: Jonathan Harvey, *Speakings*, for orchestra and live electronics
Steps to Happy Live Sound Processing

• Choose the right mic(s) for the job
  - Dynamic, condenser, ribbon, cardioid, hyper-cardioid, omni, figure 8, etc.
  - In general, in mixed music, the closer you can get, the more control you will have over the final result
  - Loud instruments that can accept a very close mic (i.e., less than an inch) will handle feedback better
    - Ex: Voice, brass instruments, electric guitar,

• EQ the input (if you have feedback with a clean channel, you will FOR SURE have feedback with you effects.

• Turn off outputs (or input)

• Turn on processing

• Slowly bring outputs backup.
  - If there’s feedback, reconsider the EQ, the mics, the speaker position, then consider using noise gates and/or compression.
  - If you simply can’t get rid of the feedback, then reconsider the type of processing you are using (not all are possible)