INTRODUCTION

Dynamic range compression is not data compression (i.e. the process in which a lossless audio codec such as WAV or AIFF is converted to a lower quality, lossy audio codec such as MP3 or M4A).

Dynamic range compression is achieved by reducing the volume of loud sounds, or increasing the volume of quiet sounds, thereby "compressing" the dynamic range of an audio signal. The process of compression has many applications in audio recording, mixing, and mastering. Audio compression is accomplished by utilizing hardware or software signal processors. The hardware or software designed for compressing audio signals is called a *compressor*.

Attenuation is the reduction of the volume or amplitude of a signal, electric current, or other oscillation.

Essentially, compression adjusts the volume of audio relative to a *threshold* level set by a control on the compressor. Audio signals louder than the threshold are *attenuated*, while sounds below the threshold level are unaffected.

Compressors can improve an audio signal's perceived quality by taming irregular volumes and improving vocal intelligibility. Harmonics and tone can also be enhanced. When audio is compressed correctly, the result should be free from noticeable fluctuations and sound "clearer" with more depth and dimension. If compression is not applied correctly (or at all), the listener might be distracted by variations in volume and need to adjust the loudness of their playback system.

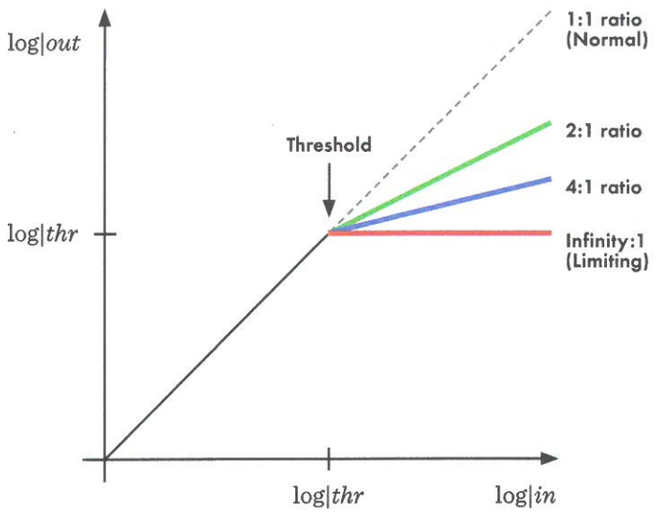
"Compression can be dangerous in the wrong hands."[2]
Chris Lord-Alge, mix engineer for Green Day's *American Idiot*

Compared to other audio effects (such as reverb), it can be challenging to set up compressors effectively, especially for beginners, because the impact of the compressor's settings is not apparent to the untrained ear. A wrongly configured compressor will introduce numerous unpleasant artifacts to an audio signal.

Methodologies

The audio compression process can be broadly categorized into two principal methodologies: downward and upward.

Fig. 1. Gain computer



The gain computer is the part of the compressor that generates the control voltage (CV) and calculates the amount of compression applied to an audio signal. Once the input signal exceeds the threshold point, it is attenuated according to the ratio setting. Ratios of 2:1 to 8:1 are generally considered normal compression, while ratios of 10:1 or higher are called limiting.

Both techniques effectively reduce an audio signal's overall dynamic range. *Downward compression* reduces sounds that exceed the threshold level, while *upward compression* boosts the volume of audio signals below the threshold level. Nearly all modern compressors employ the downward compression methodology.

Expanders and gates "expand" the dynamic range of an audio signal, effectively reducing the volume of noise.

The exact opposite of a compressor is called an *expander*. It increases or "expands" the dynamic range of an audio signal, working like a compressor in reverse.

An expander increases the dynamic range by lowering the volume level of audio below the threshold. When the ratio of an expander is set to "negative infinity," the effect is called a *noise gate*. When a signal goes below the threshold of a noise gate, its amplitude is turned to negative infinity, effectively muting the signal. Noise gates are commonly used in live sound mixing to avoid microphone feedback.