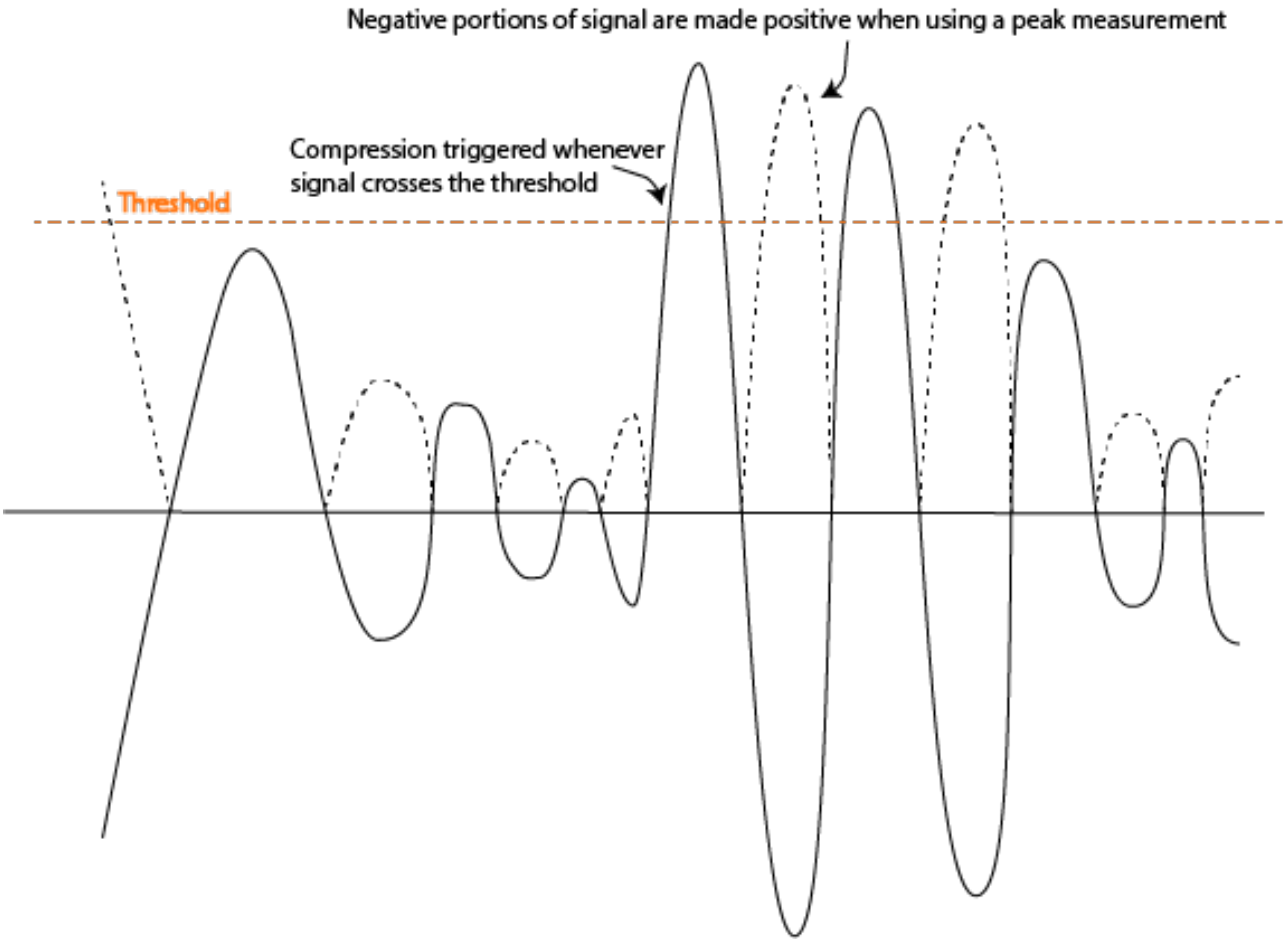
Advanced Dynamics Functions

In this lesson I'll explain some Advanced Dynamics Functions used for compression:

- Peak vs RMS
- Lookahead
- Sidechain
- Knee

Peak vs RMS
When determining whether an audio signal has crossed the threshold at which compression is applied, two techniques can be used: Peak and Root-Mean-Square (RMS). I'll discuss each of these in turn.

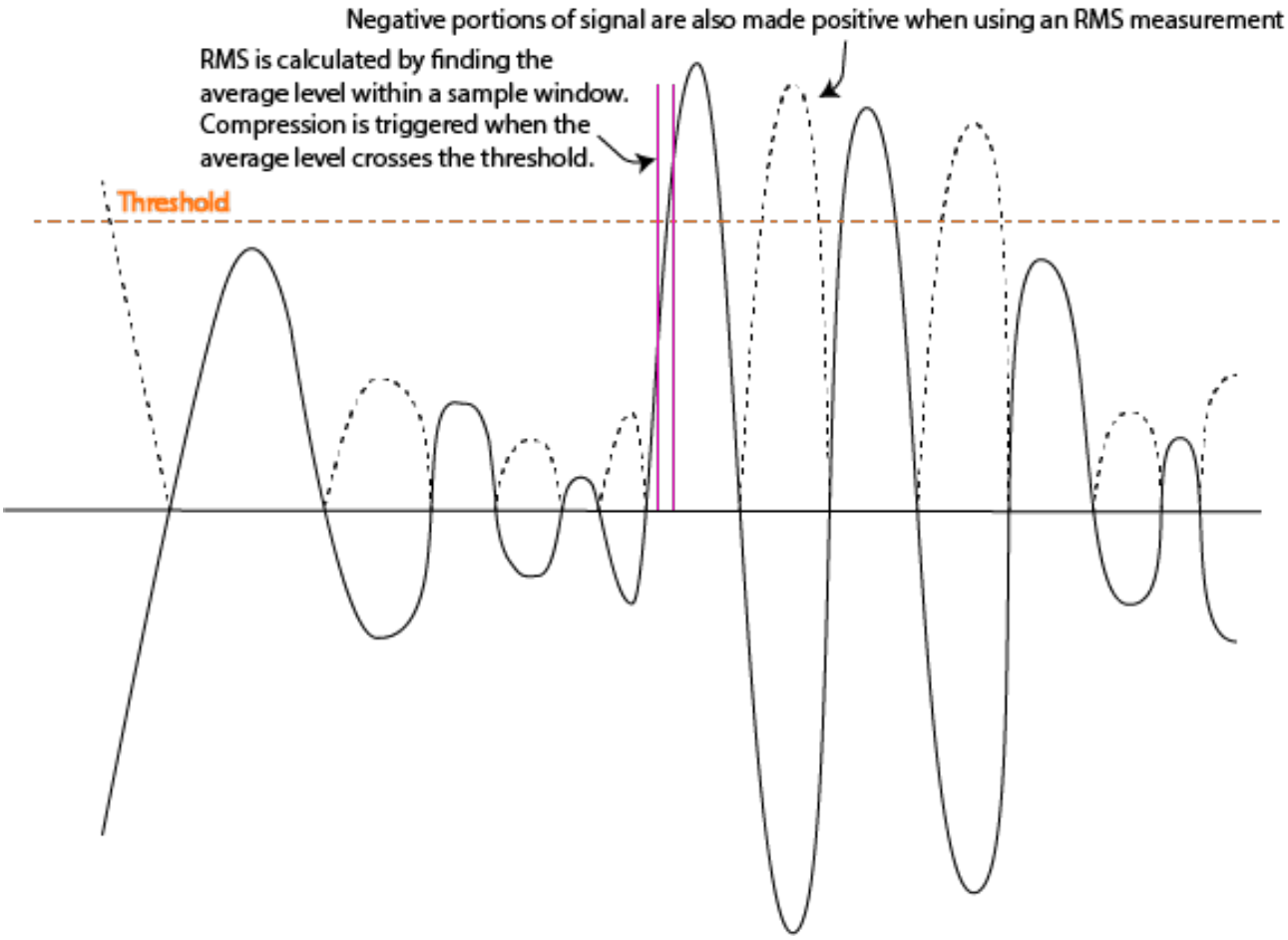
Peak measurement
An audio signal is conveyed using alternating current, which is represented digitally by samples with both positive and negative values. As the threshold is represented as a positive value, the samples must all be converted to a positive value in order to calculate the peak. This value can now be compared to the threshold. If it is higher than the threshold then compression will be triggered.



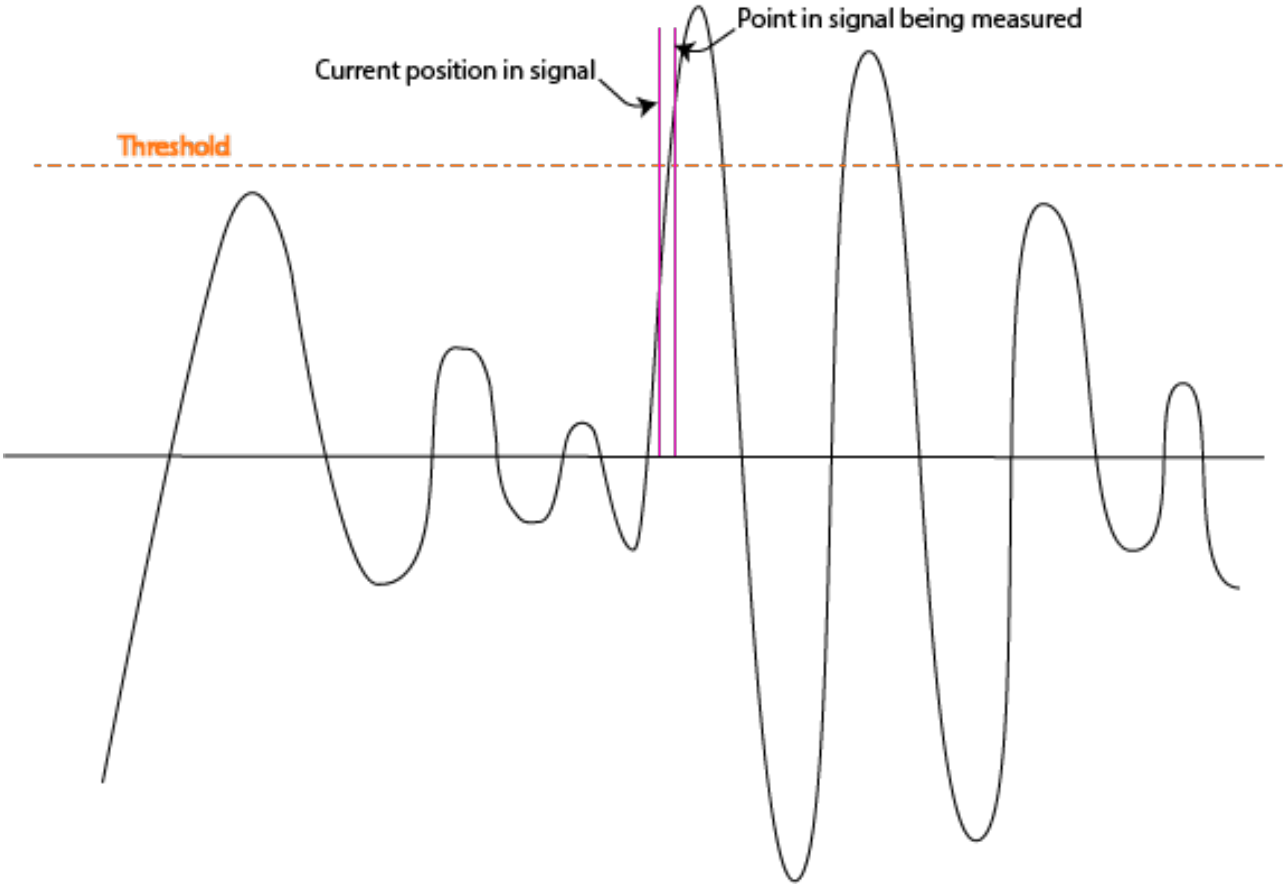
This form of measurement can be very useful for compressing signals that have very rapid, short transients, a snare drum for example, where the response needs to be instantaneous. It can also be used in a limiter, where the objective is to cap the level a signal can reach.

RMS measurement

For compression of other signals, a Peak measurement is less useful, because it does not match the way the human brain determines loudness. In human hearing, the brain perceives loudness as the average level of the sound. The RMS measurement responds to the signal in a similar way. With RMS, a brief window around the current sample is examined. This window is of a fixed length - 1ms for example, which would be 48 samples at 48,000 hertz. Each of the samples in the signal is first squared. This results in all the sample values being made positive. The mean of the samples is now calculated by adding their values and dividing by the number of samples. Now this single value must be reduced to the normal range of the signal by finding its square root. This value is now compared with the threshold. Again, if it is above the threshold, compression is triggered.



Lookahead
If the sample, or the central point of the sample window, used to trigger the dynamics processor is the sample currently being played, then really short transients may reach a high level before compression kicks in. To counter this effect some compressors use a look ahead strategy where the sample, or sample range, being measured are slightly ahead of the sample being played. In this way, compression can be activated as the transient is reached rather than slightly after it.



Sidechain

In a compressor the signal path is split into two portions. One of these carries the signal that will be processed. The other, which is known as the sidechain, carries the signal that is analysed to determine when compression is to be applied. Having a separate path for the signal to be analysed allows for more functionality. For example, the signal running through this path can be filtered such that the dynamics processor only responds to signals in a certain frequency range. The input to the sidechain can even be a completely different source from the signal being processed. For example, if your main signal is a music track, you could feed a microphone signal into the sidechain to create a ducking effect, where the level of the music track drops whenever a vocal signal is present. (Exactly the technique used by annoying radio DJ's who like to ruin a good song with their incessant talking).

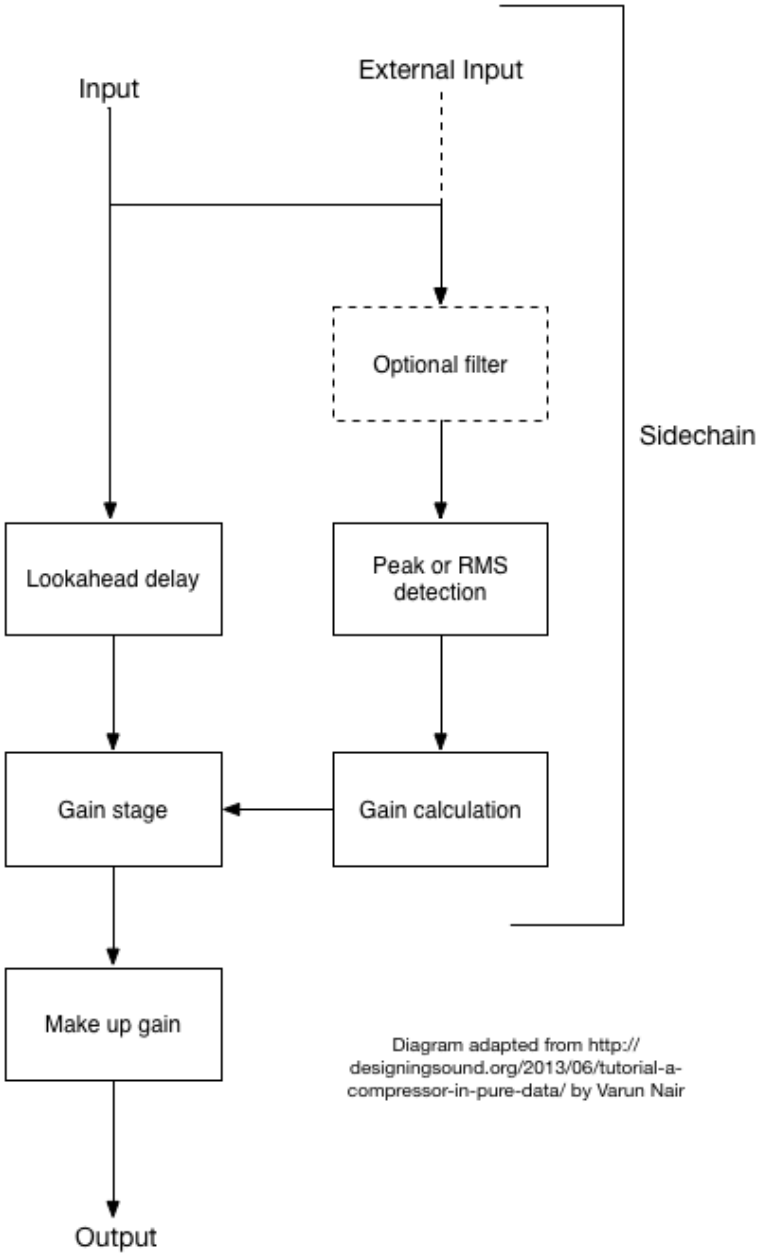


Diagram adapted from http://designingsound.org/2013/06/tutorial-a-compressor-in-pure-data/ by Varun Nair

Knee

Normally a compressor compresses the signal at the set ratio as soon as the threshold is crossed. For some signals this can result in a noticeably unmusical effect. Sometimes you want the transition from the uncompressed to the compressed signal to be more subtle. For these instances you adjust the knee so that compression begins gradually as the threshold is approached and then reaches the full ratio as the signal level moves beyond the threshold.