

Vibrato

Definition

The Vibrato produces a small change in the pitch, or frequency, normally introduced by a vibration (where the Vibrato comes from) of the music's finger on the string. It can also be done by the whammy bar (tremolo system) of a guitar. Unfortunately, the name “tremolo” was wrongly employed in the guitar bridge (as, for example, in the Floyd Rose tremolo system), which produces a changing pitch (therefore vibrato) rather than in amplitude. Fender also incorrectly used the name “vibrato” on tremolo effects of its amplifiers. Actually, vibrato produces a pitch change (frequency), whereas tremolo modulates the signal amplitude (or volume).

Vibrato

Oversampling and sub sampling are the usual techniques employed to produce pitch changing. However, these procedures produce also lags or superposition on the audio signal that needs to be adjusted by means of more complex computation or electronics (see, for instance, the algorithms for Pitch Shifter, Detune and Octave). An easy way to slightly changing the pitch is by means of a modulated time delay. The time delay introduces also latency on the output signal, but it is hardly perceived. Moreover, since there is no mixing between the dry (input) and wet (output) signals, the delay, which may cause some reverberation, is also unnoticed. The modulation on the time delay is normally done by a Low Frequency Oscillator (LFO), which drives the BBD (Brigade Bucket Device) on analog Vibratos. The mathematical model of a vibrato is therefore something like

$$y(k) = x[k - n - a f(k)],$$

where $x(k)$ and $y(k)$ are the input and output signals, and $f(k)$ is the LFO function generator. The amplitude a changes de “depth” or amount of pitch changing. The parameter n is adjusted to avoid that the modulated delay results positive which may cause audio artifacts:

$$n > -a \max(f(k)),$$

This model corresponds to the block diagram of the Z transform shown in Figure 1.

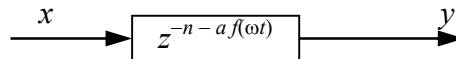


Table 1 shows some delay based effects and their dependencies on amplitude and pitch modulation, besides the number of delayed signals present in the wet output. Vibrato shares with Chorus several parameters and, therefore, can be easily done with the same algorithm.

Table 1 – Effect composition and applied modulation

| Effect | Dry | | Wet | | |
|--------------|--------|----------------------|---------------------------|------------------|----------------------|
| | Output | Amplitude modulation | Number of delayed signals | Pitch modulation | Amplitude modulation |
| Chorus | ✓ | | ≥ 1 | ✓ | ✓ |
| Vibrato | ✗ | | 1 | ✓ | ✗ |
| Delay & Echo | ✓ | ✗ | ≥ 1 | ✗ | ✗ |
| Reverber | ✓ | ✗ | $\gg 1$ | ✗ | ✗ |
| Flanger | ✓ | ✗ | 1 | ✗ | ✗ |
| Tremolo | ✓ | ✓ | 0 | ✗ | ✗ |

Vibrato shares with Chorus several properties. In fact, Vibrato may be seen as a simple Chorus without mixing with the dry signal. GSP creates the Vibrato with the Chorus class and just assures that there is no mixing between the dry and wet signals.