

EL-6183

GUITAR EFFECT UNITS

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Effects unit

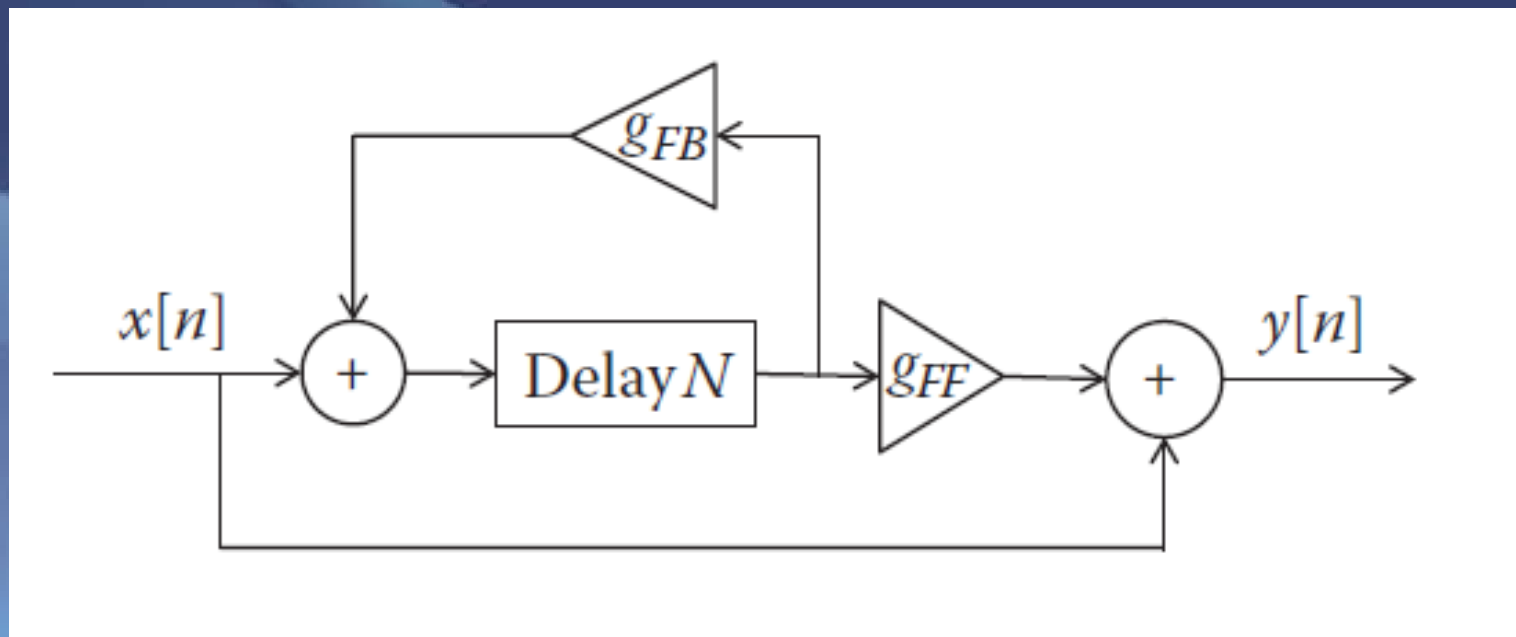
- An Effects unit (effect box, stompbox, pedal) is an electronic device that alters how a musical instrument or other audio source sounds.
- Some effects subtly "color" a sound, while others transform it dramatically.
- In DSP views, we pass the signal to specified filter or LFO(low frequency oscillator) to implement these effects

Effects units processing

- Basic Filtering — Low-pass, Band-pass, High-pass filter, Equalizer, etc.
- Time Varying Filters — **Wah-wah**, Phasor
- Delays — Vibrato, **Flanger**, Chorus, **Echo**
- Modulators — Ring modulation, Tremolo, Vibrato
- Non-linear Processing — Compression, Limiters, **Distortion**, Exciters/Enhancers
- Spatial Effects — Panning, Reverberation, Surround Sound

Delay effect

- Time-Based effect
- Illusion of an echo
- Placed near the end of the signal

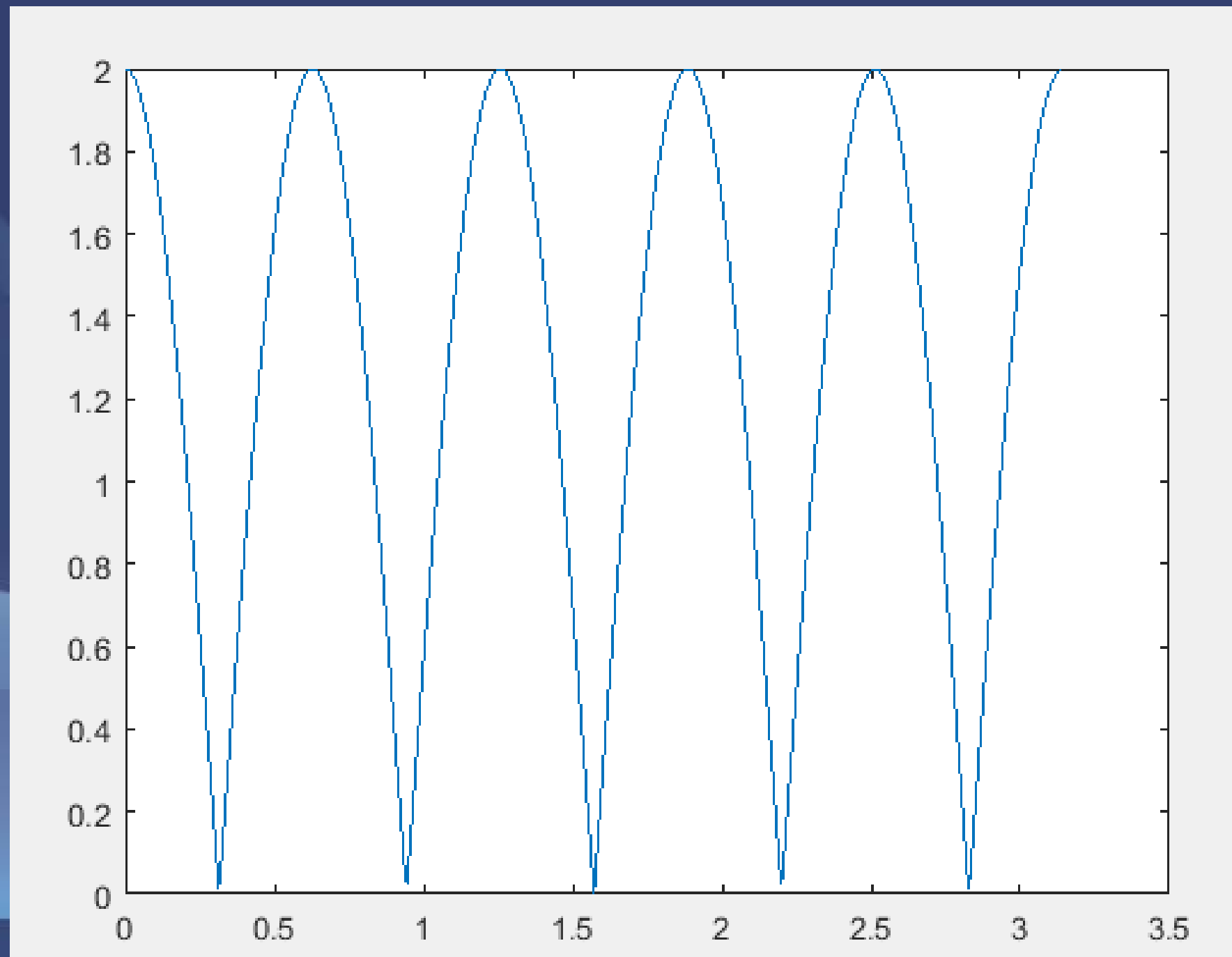


Implementation

- Using circular buffer
- Delay time \rightarrow index for the circular buffer
- Feed delay back to direct path \rightarrow Echo

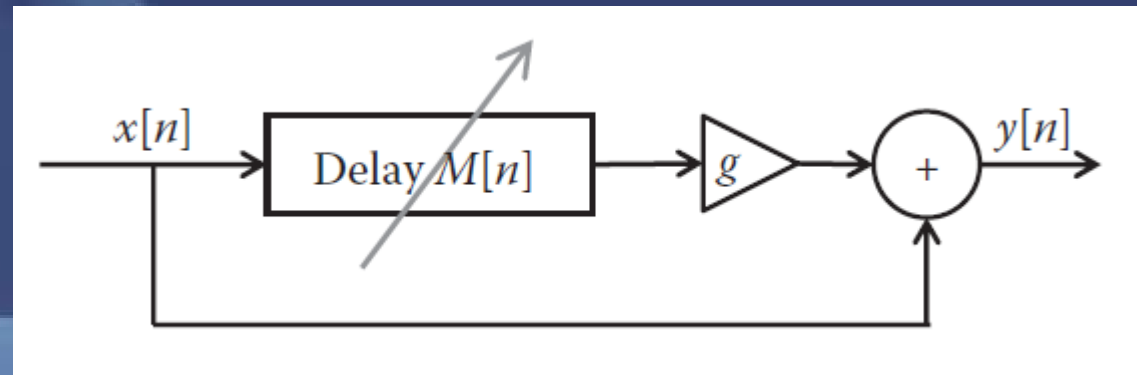
Flanger effect

- Lfo f
- W



Implementation

- Sweeping buffer index as a sinusoid increment
- $w * \text{math.sin}(2 * \text{math.pi} * f * n / \text{RATE} + \text{theta})$



Fuzz

- Fuzz pedals create a warm, gritty sound by clipping the guitar's audio signal and adding overtones.
- Plays an important part in electric guitar music, especially rock music and its variants.
- Fuzz is a completely nonlinear effect that creates drastic changes to the input waveform, resulting in a harder or harsher sound.

Implementation

- A non-linear function commonly used to simulate fuzz is given by:

$$f(x) = \frac{x}{|x|}(1 - e^{\alpha x^2/|x|})$$

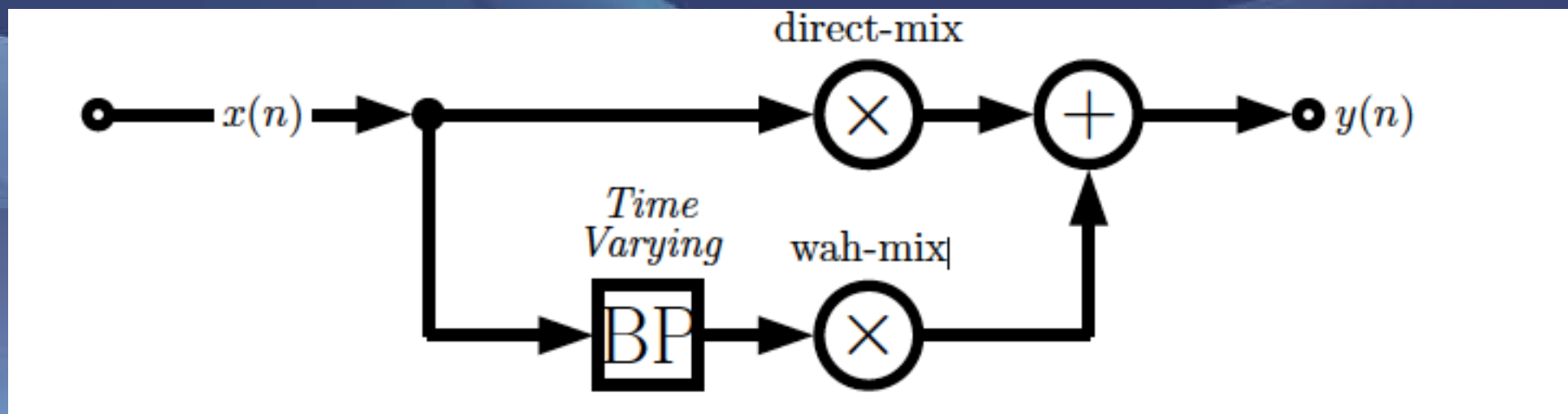
- This is a non-linear exponential function
- The gain α , controls level of fuzz.
- Have a mix part of the distorted signal with original signal for output.

Wah-wah effect

- The Wah pedal is a time varying filter effect (Band-pass filter).
- Produce a vowel like sound by altering the frequency spectrum of an instruments signal.
- A foot pedal is tilted a volume boost sweeps through the frequency range.

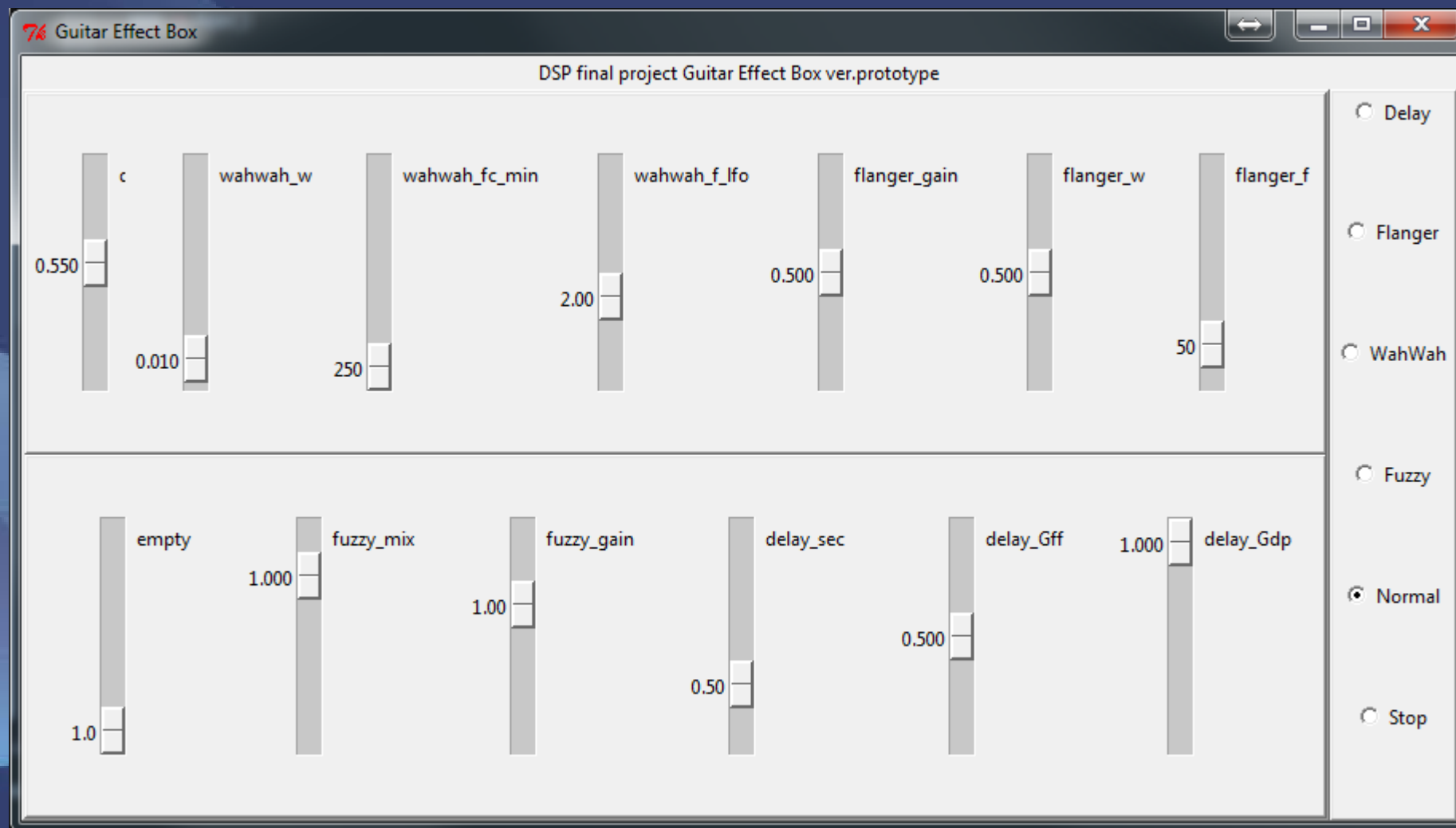
Implementation

- Sweep central frequency of the bandpass filter back and forth following a low-frequency oscillator (LFO) with an adjustable frequency, called Auto-Wah



Interface design

- Tkinter 8.5 on python 2.7
- To work on Mac OS X, install “ActiveTcl”



Reference

- http://www.cs.cf.ac.uk/Dave/CM0268/PDF/10_CM0268_Audio_FX.pdf
- Text Book: Audio Effects Theory, Implementation and Application by Joshua D. Reiss and Andrew P. McPherson