Oscillator Algorithm

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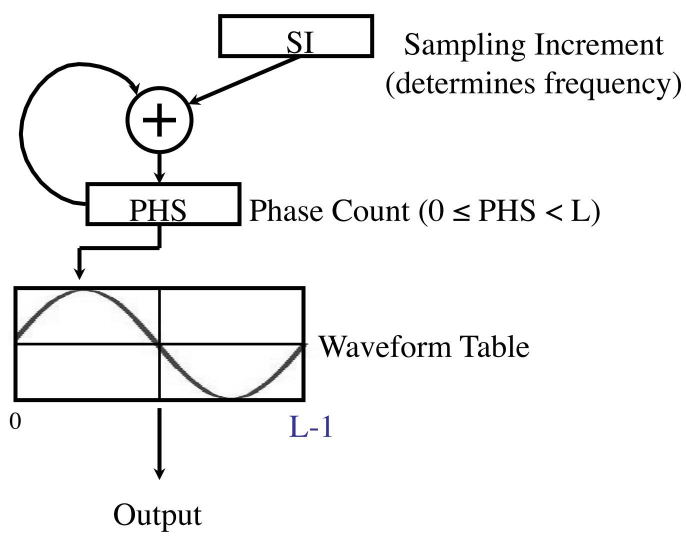


Sampling Increment

If SI = 1.0:

$$freqF = \frac{SR}{L}$$

exp.: 43 Hz = 44100 / 1024

To create a specific target frequency:

$$SI = \frac{freqT}{freqF}$$

exp.: 10.23 = 440.0 / 43

Or:

$$SI = \frac{L * freq.}{SR}$$

Oscillator Stages

Initialization:

$$SI = \frac{L * frequency}{SR}$$

PHS = 0 or other initial value

Sample Rate:

PHS = (PHS + SI)%L

IPHS = int(PHS)

OUT = WAVE(IPHS)

⋮

etc.

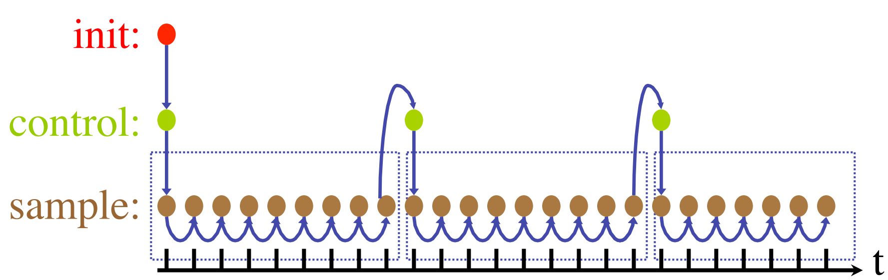
General Stages

Initialization: once

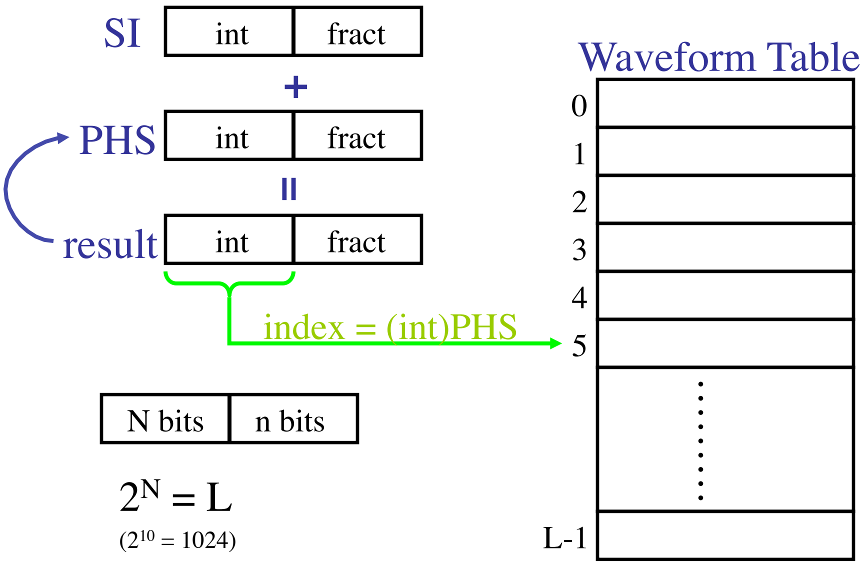
Control rate: every n samples

Sample Rate: SR / second

Program Flow



Oscillator Detail



N bits	n bits

n determines the frequency accuracy

n	Δf
0	43.066
4	2.692
8	0.168
12	0.0105
16	0.000657

SR = 44100
L = 1024

How much accuracy is necessary?

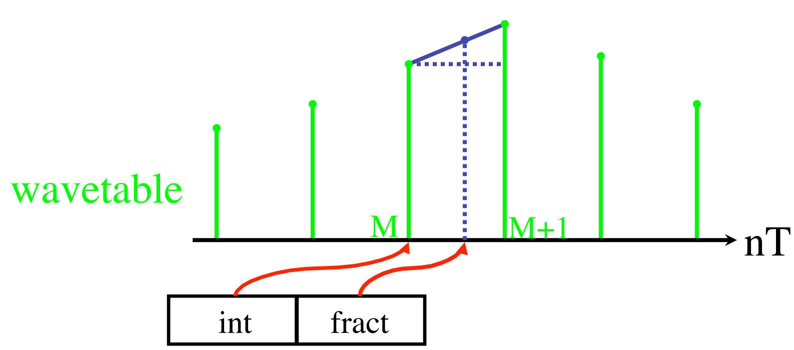
Signal to Noise

Depends on L & method

L	oscillator	interpolated
256	36 dB	84 dB
512	42	96
1024	48	108
2048	54	120

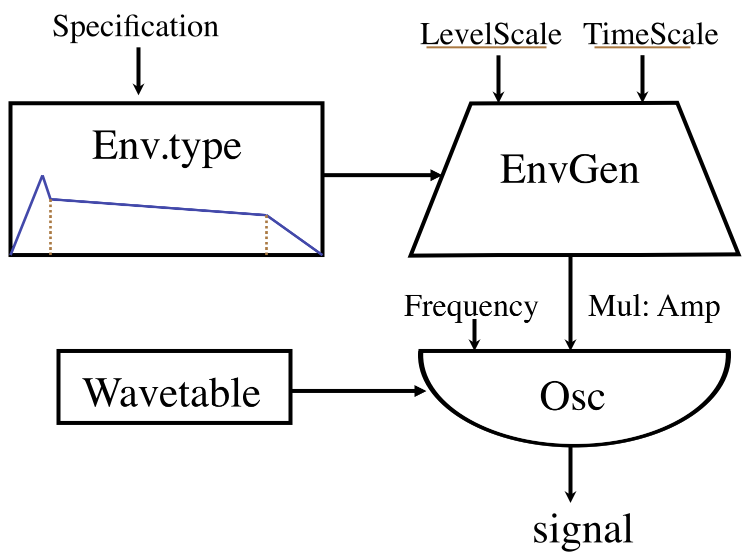
Trade-off

Interpolating Oscillator

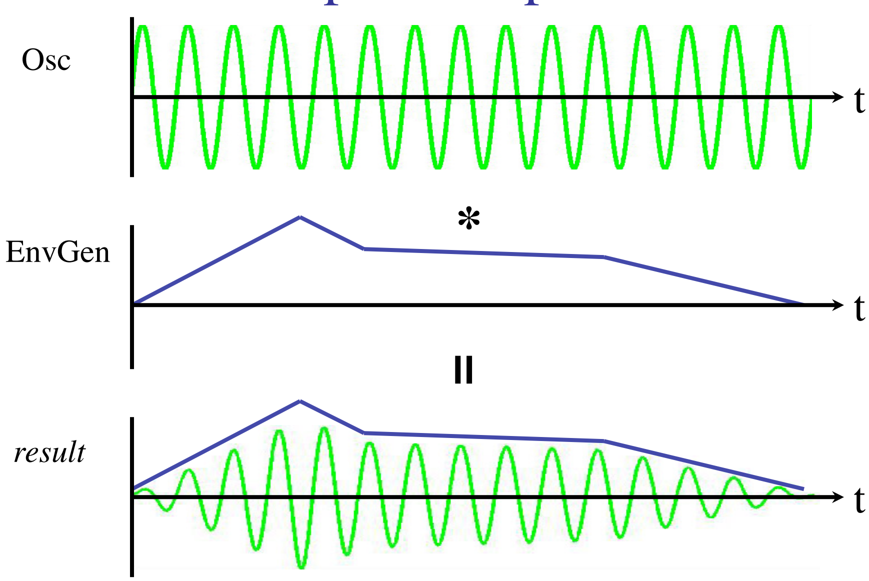


output = wavetable(M) +
fract*(wavetable(M+1)-wavetable(M))

Envelope Generator

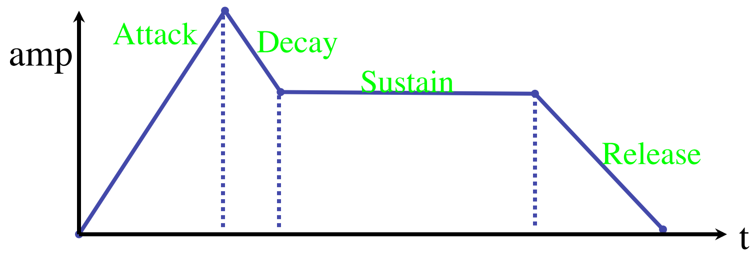


Envelope Multiplication



Env: Changing Amplitude

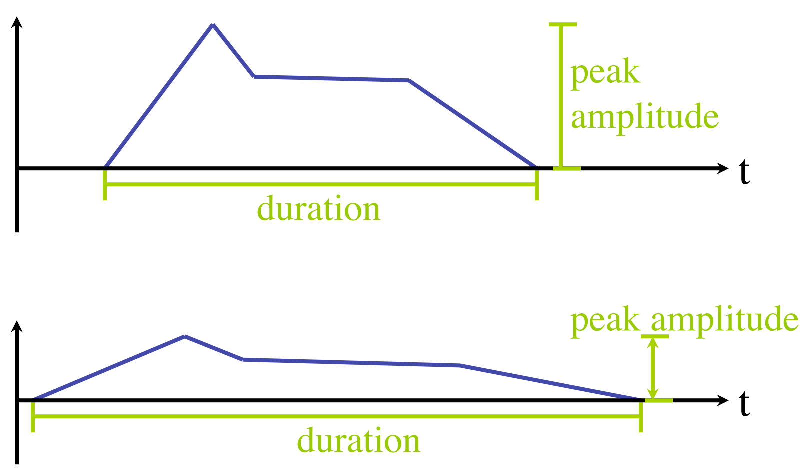
Type: ADSR



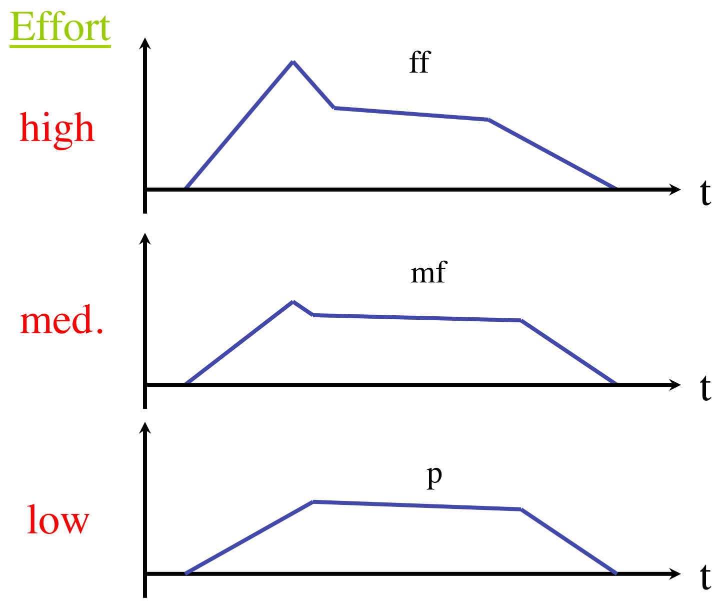
Specification:

0	
peakLevel	attackTime
sustainLevel	decayTime
sustainLevel	sustainTime
0	releaseTime

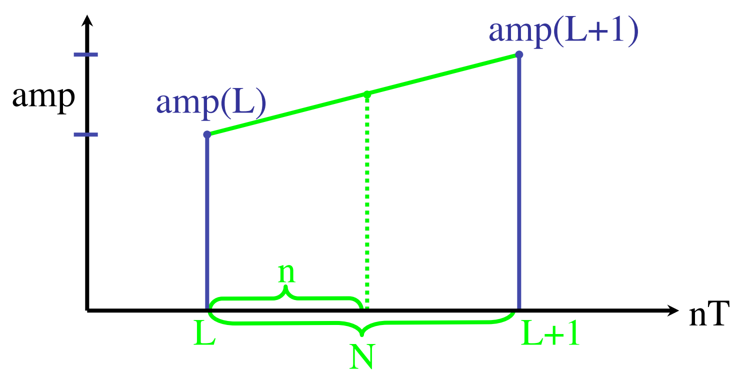
Envelope Scaling



Real Instruments



Interpolation by Sample

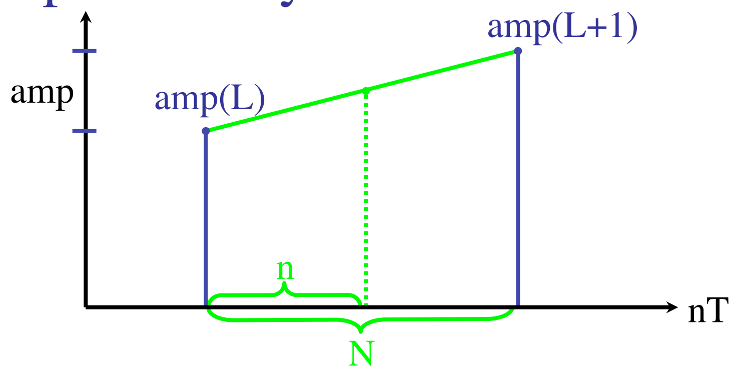


$$amp = amp(L) + \frac{n}{N}(amp(L+1) - amp(L))$$

operations count:

+	=	*	/
1	1	1	1

Interpolation by Successive Addition



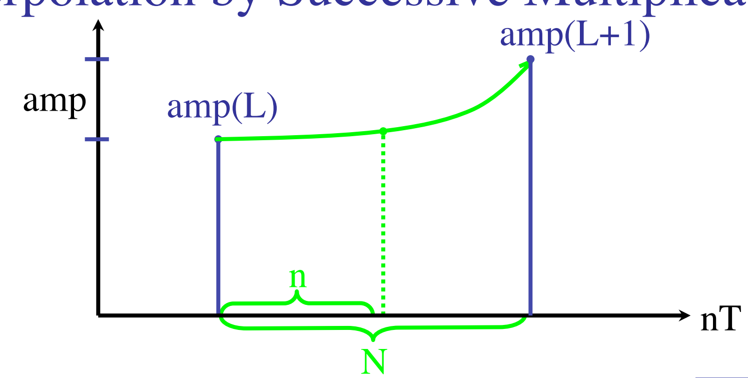
initialization: amp = amp(L)

$$\Delta amp = \frac{(amp(L+1)-amp(L))}{N}$$

loop: amp = amp + Δamp (N times!)

	+	=	*	/
operations count:	1	0	0	0

Interpolation by Successive Multiplication



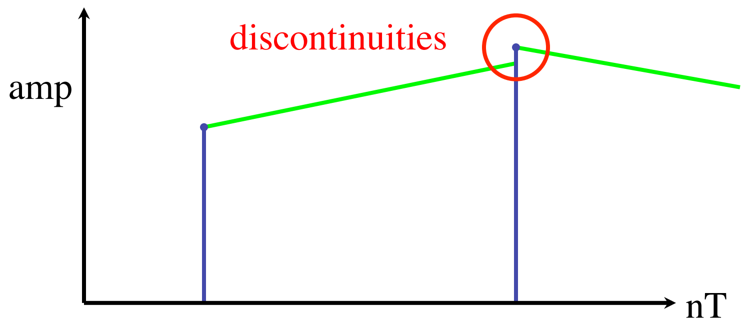
initialization: amp = amp(L)

$$\Delta amp = 10 \text{ pow}\left(\log \left(\frac{Amp(L+1)}{N} \right) - \log (Amp(L)) \right)$$

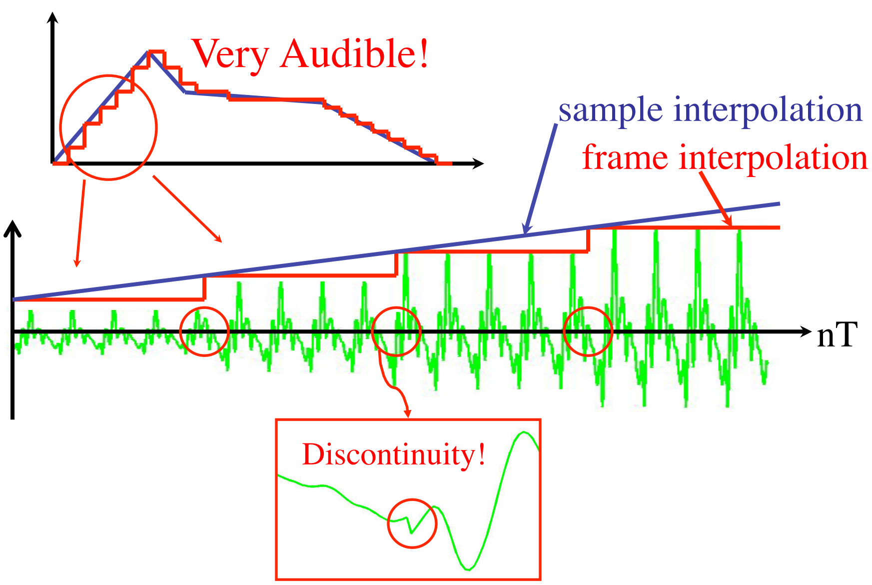
loop: amp = amp * Δamp (N times!)

	+	=	*	/
operations count:	0	0	1	0

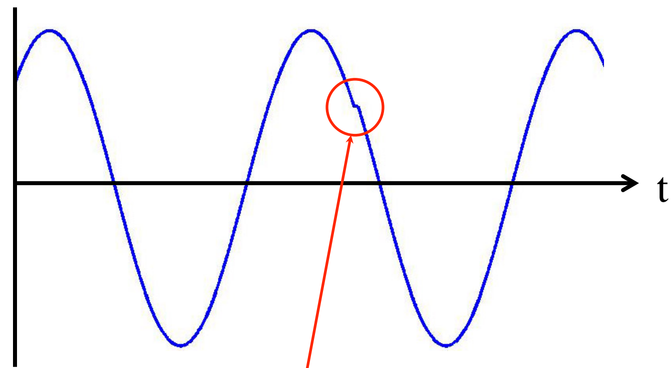
Problems



Changing Amplitude at low Control Rate

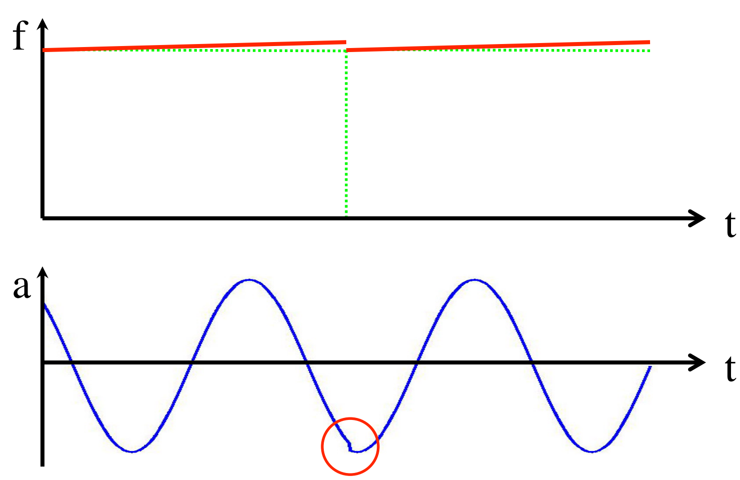


Discontinuities in Samples



Sample hold for 2 sampling instances!
Audible Click

Discontinuities in Phase/Frequency



Very Audible

SuperCollider

control rate

$$kr = \frac{44100}{64} = 689 \text{ Hz}$$

block rates?

$$\frac{44100}{1024} = 43 \text{ Hz}$$

$$\frac{44100}{512} = 86 \text{ Hz}$$

$$\frac{44100}{128} = 344 \text{ Hz}$$