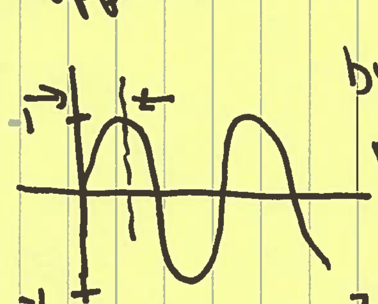
Lecture 19

Digital waveform generation

Suppose you want to implement

$$y(n) = \sin(\omega n)$$

possible to use a Taylor Series approximation



bounded
periodic

"wavetable synthesis"

z-domain

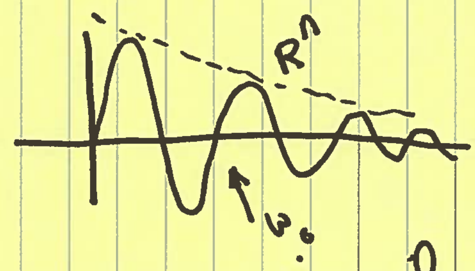
$$H(z) = \frac{1}{1 + a_1 z^{-1} + z^{-2}}$$

"digital filter-based synthesis"

$$h(n) = R^n \sin(\omega_0 n) u(n)$$

$$H(z) = \frac{R \sin \omega_0 z^{-1}}{1 - 2R\cos\omega_0 z^{-1} + R^2 z^{-2}}$$

"digital resonator"



if $R = 1$: sinusoid
$R < 1$: damped

application: "digital telephony"

push button phones

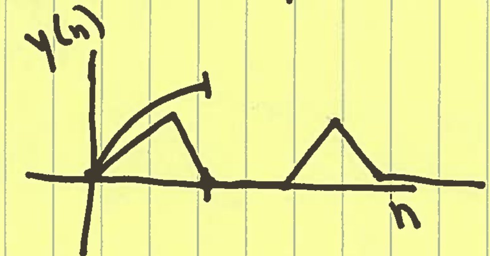
$$H(z) = \frac{Y(z)}{X(z)} = \frac{R \sin \omega_0 z^{-1}}{1 - 2R\cos\omega_0 z^{-1} + R^2 z^{-2}}$$

$$Y(z)[\quad] = X(z)[\quad]$$

$$Y(z) = \alpha z^{-1} Y(z) + \beta z^{-2} Y(z) + X(z) + \cdots$$

$$y(n) = \alpha y(n-1) + \beta y(n-2) + x(n) + \gamma x(n-1)$$

Wavetable synthesis



store samples of the first $\frac{1}{4}$ cycle (sin)

worst case: store entire period

amount of memory $\propto f_s$

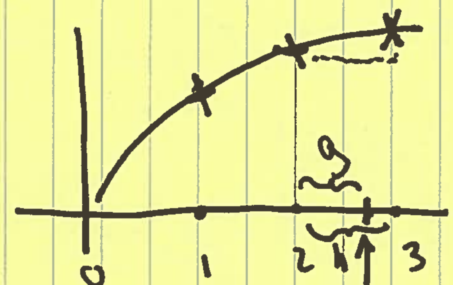
what if $f_s = k f_0$ k = integer

if $f_s \neq k f_0$: interpolate

~~sen~~ $f_s / k = f_0$ constraint

compute address and fetch value → 1 cycle

Interpolation:



$n = 2.75$

$\frac{g}{h}$

push Exam #2 to the 3/23!