

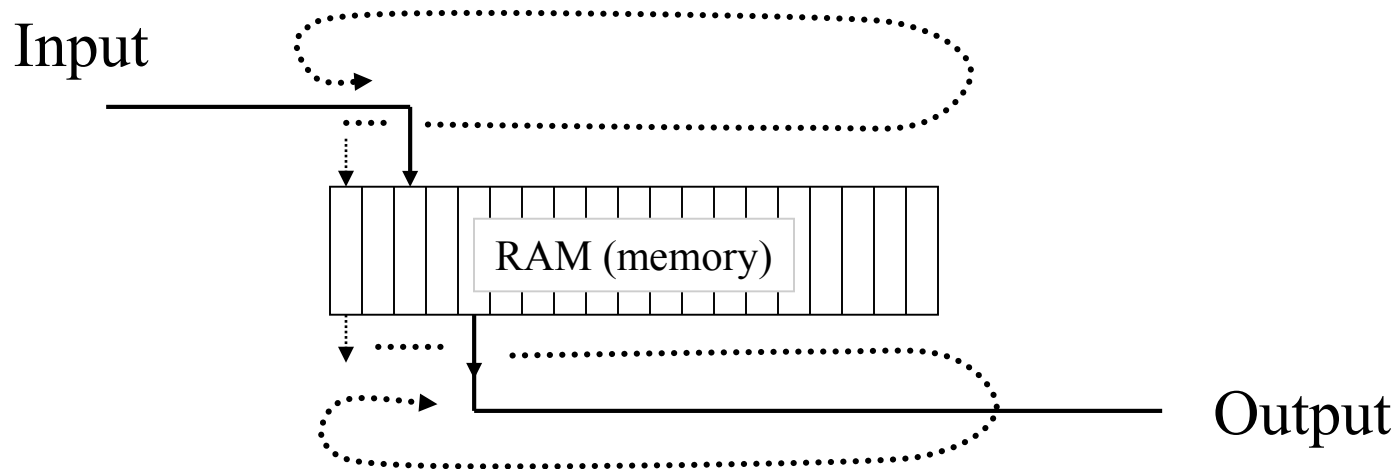
Basic Digital Audio Effects

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EELE 417/517

Digital Delay

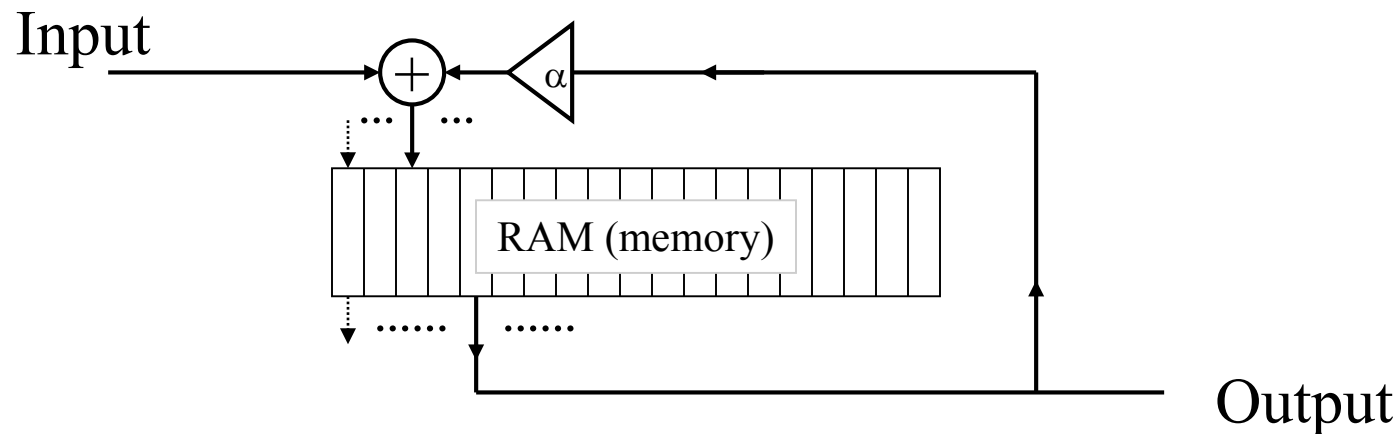
One sample after another is written
into memory...



...and read out later. Delay is the
number of samples between *write*
pointer and *read* pointer.

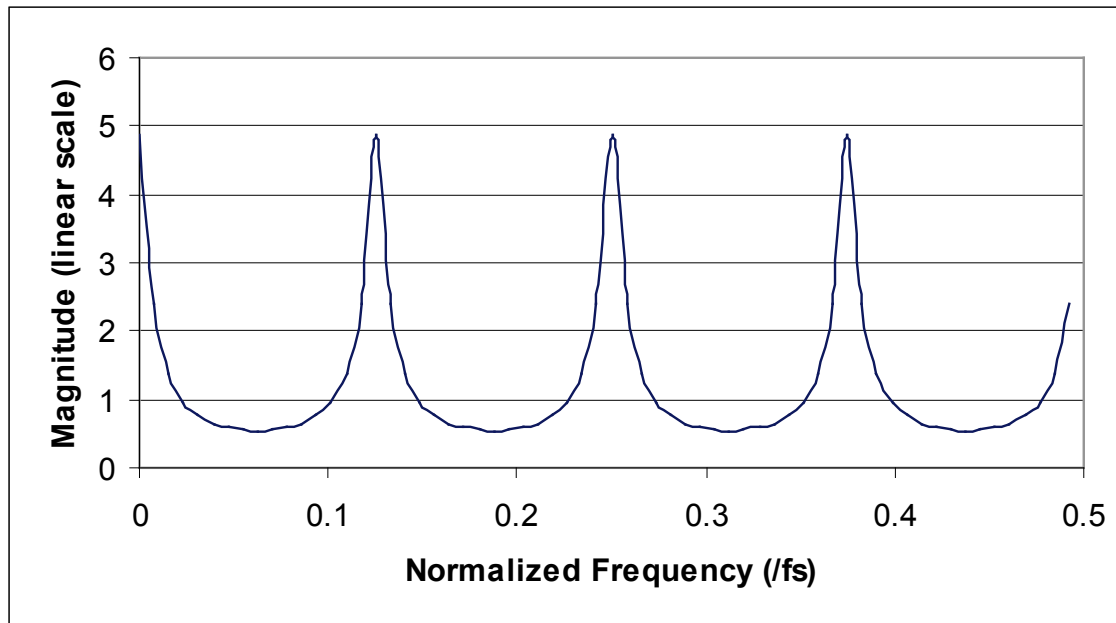
Recirculating Delay: Echo

Delayed output is attenuated and added back in with the input samples.



Recirculating Delay (cont.)

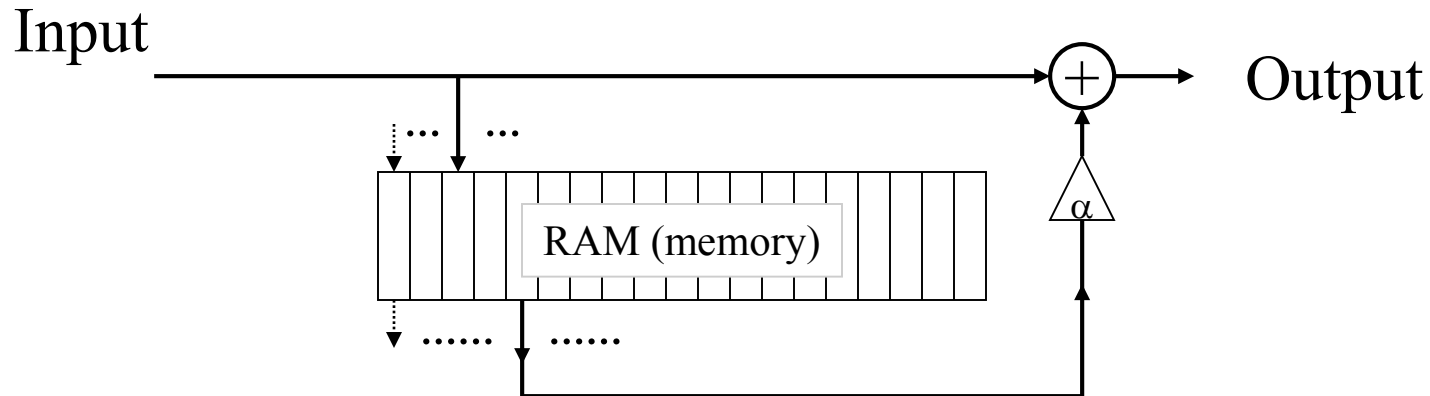
- Frequency response of system



- A “comb” filter. Frequency at peaks depends on delay length.

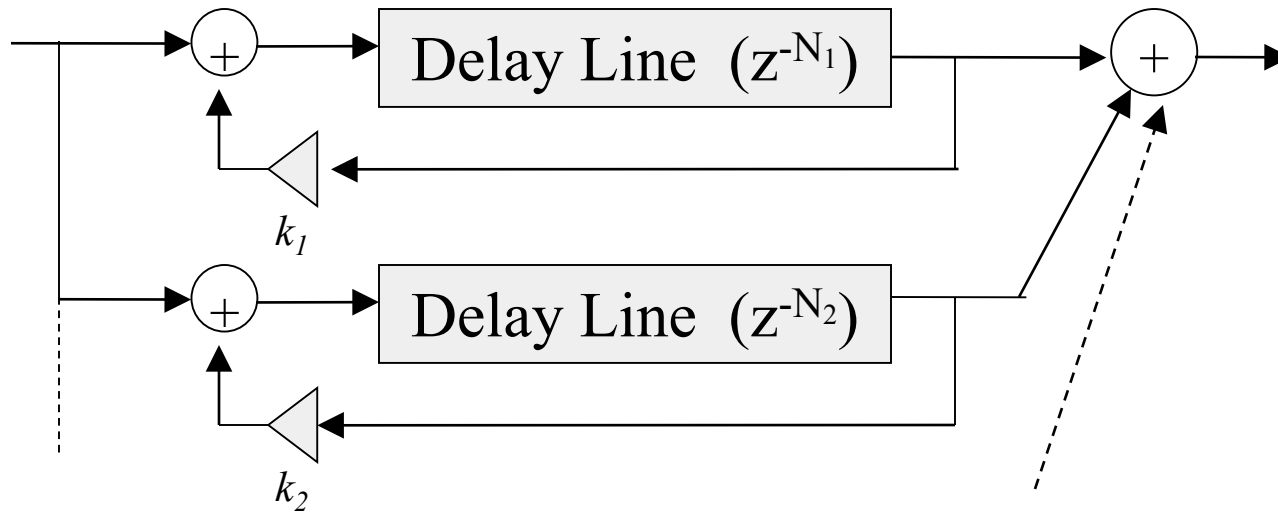
Time-Varying Delay: Flanger

Feed forward: delayed output is added back in with the input samples. Delay varies up and down as a function of time.



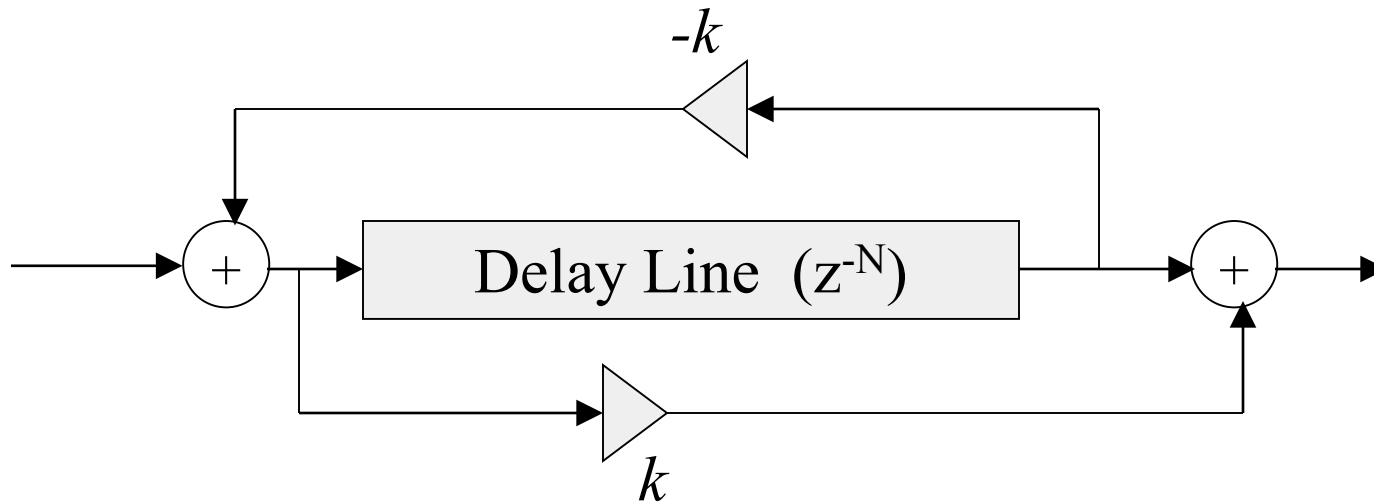
Reverb Simulation

- Plan: use parallel recirculating delay lines with incommensurate delays



Other Improvements

- Cascade of *all pass* recirculators

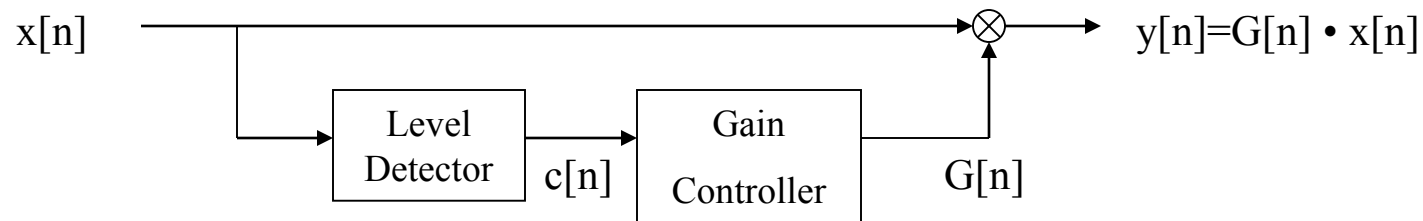


$$H(z) = \frac{k + z^{-N}}{1 + kz^{-N}}$$

N poles and zeroes equally spaced around circle
(pole radius $k^{1/N}$, zero radius $k^{-1/N}$)

Gain Control

- Gain control framework



- $c[n]$ can be $|x[n]|$, envelope of $x[n]$, RMS value of $x[n]$, etc.
- Level detector typically has attack and release time constants