Comb filter

In signal processing, a comb filter adds a delayed version of a signal to itself, causing constructive and destructive interference. The frequency response of a comb filter consists of a series of regularly spaced notches, giving the appearance of a comb.

1 Applications

Comb filters are used in a variety of signal processing applications. These include:

- Cascaded integratorcomb (CIC) filters, commonly used for anti-aliasing during interpolation and decimation operations that change the sample rate of a discrete-time system.
- 2D and 3D comb filters implemented in hardware (and occasionally software) for PAL and NTSC television decoders. The filters work to reduce artifacts such as dot crawl.
- Audio effects, including echo, flanging, and digital waveguide synthesis. For instance, if the delay is set to a few milliseconds, a comb filter can be used to model the effect of acoustic standing waves in a cylindrical cavity or in a vibrating string.
- In astronomy the astro-comb promises to increase the precision of existing spectrographs by nearly a hundredfold.

In acoustics, comb filtering can arise in some unwanted ways. For instance, when two loudspeakers are playing the same signal at different distances from the listener, there is a comb filtering effect on the signal.[1] In any enclosed space, listeners hear a mixture of direct sound and reflected sound. Because the reflected sound takes a longer path, it constitutes a delayed version of the direct sound and a comb filter is created where the two combine at the listener.

2 Technical discussion

Comb filters exist in two different forms, feedforward and feedback; the names refer to the direction in which signals are delayed before they are added to the input.

Comb filters may be implemented in discrete time or continuous time; this article will focus on discrete-time implementations; the properties of the continuous-time comb filter are very similar.