All Pass, fexible FX tool: vibrato, leslie, phasing, delay ...

In 1962 Manfred Schroeder presented a digital version of the analogue allpass filter. Actually an extension of the comb filter. Such an allpass network is an extremely multifunctional and widely used sound tool in current sound processing and synthesis techniques.

Allpass filter
Only about ten years after Schroeder's digital version, the analogue predecessor started his first great success. This kind of analogue filters formed the heart of the popular phasing stump boxes from the seventies of the last century. A few examples: MXR phase 90, and the ideal then, the Moog 12 stage phaser in 19 inch form, composed of 12 series-connected analog all-pass filters. And, not to mention the Mutron Bi-Phase from Musitronics, another 'wanna have' twice 4 stage phaser from those years.

For the time being, we stay with only one all-pass element, also called a first order allpass. Such an allpass filter is a strange thing. As the name suggests, it allows all frequencies to pass without changing the amplitude. The effect of an all pass filter you hear best at the attacks of sounds. And, if you quickly sweep the frequency setting up and down, a vibrato effect is created. The peculiarity of this filter lies in the fact that it provides different frequencies with different time delays, which are caused by phase shifts. This phenomenon is known as dispersion.

The effect of dispersion is difficult to express in words, although it is very recognizable by the ear. A subjective description such as: of those nice 'wet' attacks, for me, comes most closely to the essence of the sound sensation. It arises, as said, because different sub-frequencies in a sound are delayed to varying degrees.

For me, one of the best known examples of sounds with a clear dispersion is the Hammond organ, especially the B3 and relatives. You can find two very clear explanations for this.

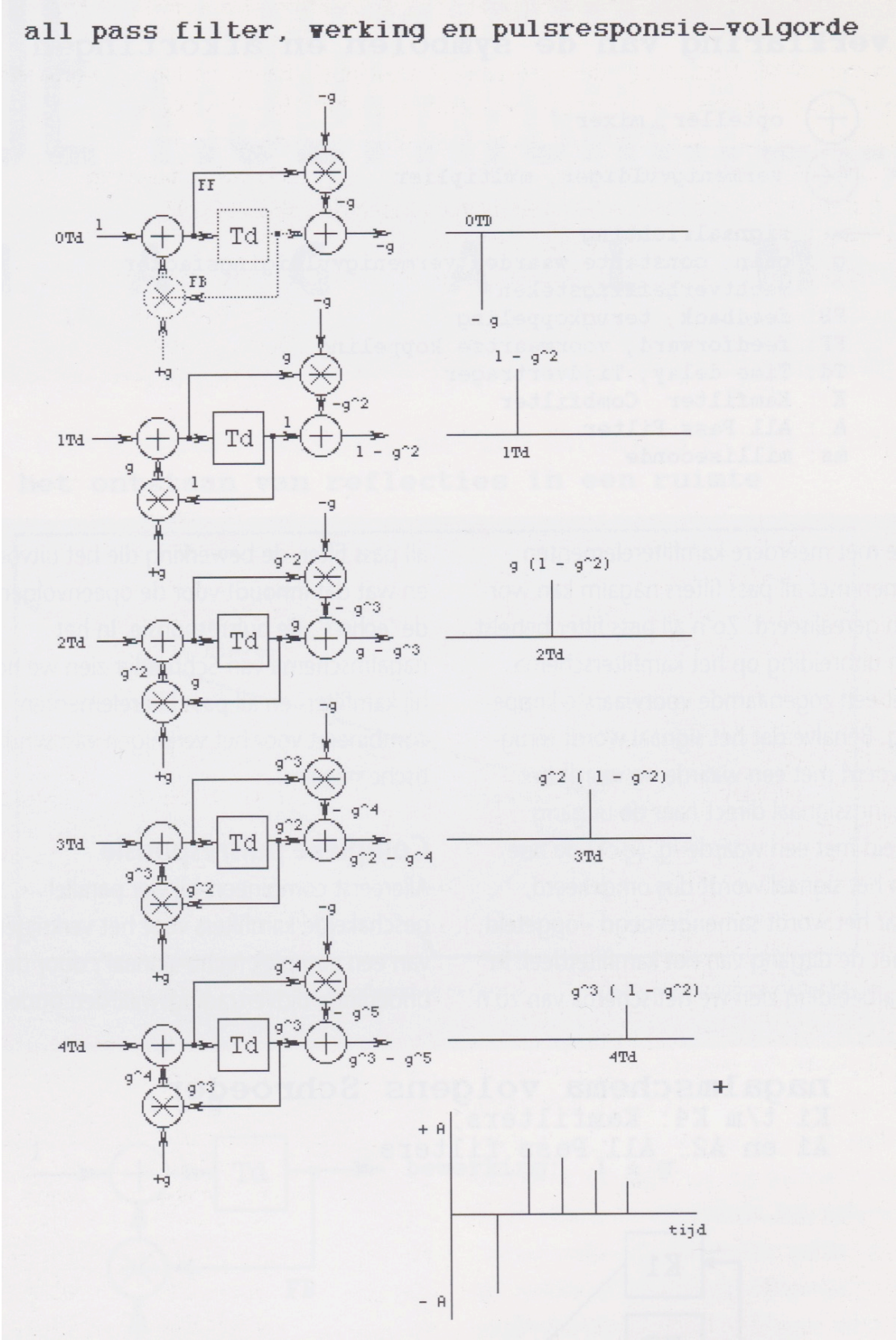
First. Each tone is made up of distinct sub-tones, the so-called footages. 9 switches (for each footage one) are located under each key. Ideally these switches would switch exactly at the same time. But even at Hammond, ideal and reality were two. The practice is therefore that small time differences arise in the switching moments, which can then also be different for each test. In short, dispersion, with the result of small mechanical imperfections.

Second. At such a B3 you will find a vibrating device that, if you turn it on, will strengthen the dispersion effect. Especially with the so-called chorus vibrato modes. The dispersion phenomenon can be explained

here by an electromechanical cause. The scanner system is considered an electromechanical implementation of a delay line.

This scanner vibrator system was Hammond's response to Donald Leslie's discovery. Leslie was very enthusiastic about the Hammond organ, but he felt that something was missing. He offered Hammond his invention, who however refused it. That is how Leslie started his own company, with resounding success. Hammond hoped to eliminate Leslie's competition with the scanner vibrato system. However musicians/organists decided differently: the two systems complemented each other beautifully. Hammond could not ignore it. Later Hammond bought the Leslie company: if you can not beat them, join them.

Manfred Schroeders digital all-pass network
This digital variant from 1962 includes an extension of the already known comb filter, a delay line with feedback. The extension consists of a so-called negative feed forward connection (the signal is inverted, or multiplied by -1 multiplied by the signal at the output). If we insert one sample with value 1, the output appears: 1 - g^2. This is called the impulse response, which represents the exact processing of the system.



Such a pulse response description is the counterpart of the operation in the frequency domain, the frequency characteristic, which in principle amounts to the same thing. The realization at the bottom left of the image is the way Schroeder realized his allpass network, which

saved one delay element.

That was of course very important in 1962. The large mainframe computer on Bell Labs that Schroeder used worked for hours to make a sound. That was the goal for which he applied this allpass network: achieving a higher density for an artificial reverberation.

This 'Schroeder reverberation' was formed by four parallel comb filter elements, which were mixed together and then fed into two series-connected all-pass networks. Through this work you can consider Schroeder as the father of the electronic reverberation. You can find his basic ideas in all subsequent commercial reverb processors.

But, such an all-patch patch is far more effective, and that is central to this article. With only one first order all-pass patch, with or without a low pass filter in the feedback loop and time delay modulation with for example a lfo, you can already generate a range of effects.

Allpass patches
You can listen to these effects on the basis of two basically the same patch attachments: Allpass-Patches and Allpass-FX. The first Allpass-Patches is intended for the G2 demo software and features a self-playing mini synth. Allpass-FX is meant for the real hardware G2 because it uses the external audio input.

The yellow modules in the left-hand column concern the all-pass network implementation. The bright yellow modules accommodate the tweak parameters, the light yellow give the fixed parameters necessary for the correct all-pass operation. In the right-hand column you will find the mini synth as brightly colored turquoise modules.
The lighter approved modules of the same color represent the virtual player of which a lfo forms the heart. Under the mini synth you will also find the modulation section for the allpass network.

Variations
The first version 1 Large Mod, phasing to delay, gives you an impression of what happens when the delay time is modulated by a lfo over such a large area that effects arise with as one extreme echoes delays and as other extreme phasing-like sounds.

For almost all variants, the effect is ultimately obtained by mixing the signal from the allpass network with the dry input signal. Frequencies that are in phase with each other will reinforce each other. However, frequencies that are in opposite phase will extinguish each other.

This results in a comb filter-like characteristic in the mixing result. However, the peaks and valleys are now no longer in precise harmonic proportions. In the variations 7 & 8 you can hear very well what effect

this has. The dispersion is also clearly audible here. Tweak the feedback value g and you notice that this is, as it were, the depth parameter: the greater the value, the clearer the all-pass effect. The time delay setting is done here with the Semi button.

You set the time delay using note numbers. Change these pitch / time delay settings and hear how the sound spectrum changes. In variation 7, a fixed time delay is used: a little while through the bend, a 'stagnant phaser effect'.

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literature

[i] M. R. Schroeder.
Natural-sounding artificial reverberation.
J. Audio Eng. Soc., 10 (3): 219-223, 1962

internetlinks
over Manfred Schroeder
www.physik3.gwdg.de/~mrs/
www.ieee.org/organizations/history_center/sloan/ASSR_Oral_Histories/mschroeder_transcript.html
www.aes.org/technical/111Heyser.cfm

Allpass
www.harmony-central.com/Effects/Articles/Reverb/allpass.html

Phasing:
www.harmony-central.com/Effects/Articles/Phase_Shifting/

Leslie
theatreorgans.com/hammond/faq/hammond-faq.html#SEC23

Clavia Nord Modular G2
www.xs4all.nl/~rhordijk/G2Pages/
G2 Forum, veel gratis patches
www.electro-music.com/forum/viewforum.php?f=43