Jaap Vink's Multiplied Feedback

Remarkable Physical Model-inspired patch from the 1960s.

Long before the concept of Physical Modeling Synthesis became commonplace, Jaap Vink developed a patch which already anticipates models that would not appear in the literature until much later as the so-called MSW (after their authors McIntyre, Schumacher and Woodhouse) and Karplus-Strong (named after Karplus and Strong). Both synthesis principles mentioned are based on an audio delay line as a resonator, as an example of the acoustic variants: strings and air columns. In Vink's multiplied feedback, the resonator implementation has been expanded with a reverb function.
Are you interested in drones, FX, broad spatial evolving soundscapes including sounds with instrumental and/or organic quality? Get started with software and hardware such as VCV Rack and/or Eurorack and discover that with only 6 modules, connected together as Multiplied Feedback (MFb), you can realize a vast range of sounds…

Multiplied Feedback as an Oscillating Excitator-Resonator System

In his own words, Vink's patch was inspired by a bowed violin string, as he told Hans Kulk and me when visiting him in 2014. As far as I know, it is the very first musical instrument related analogue patch with a physical model as inspiration. (Of course, in analogue computation physical models have been patched as from the early 50's, however not in some musical instrument contex.) MFb Fig 1 and also MSW Fig 3 are both abstractions of such a physical model: an EXCITATOR-RESONATOR model, more specifically a so-called self-oscillating system as we know from bowed and wind instruments. The hallmark of such a system is the interaction which occurs between excitator and resonator, resulting in a repetitive balancing whole, resoundingly expressed in the dynamic structure of the output signal, both in amplitude and waveform. In perception this means dynamics in loudness and timbre, which is an all-determining characteristic of mechanical and biological acoustic sound sources.

MFb presented schematically

In Fig 2 you see the schematic representation of the patch indicated with current module names and with names as they were/are common at the Institute of Sonology State University Utrecht where Vink developed the circuit in the sixties. In the software variant with VCV, only 6 modules are sufficient: VCO, RANDOM or LFO as Input, DELAY and REVERB as RESONATOR, and RINGMODULATOR/MULTIPLIER as Interactor with a COMPRESSOR in the feedback connection which protects the patch from infinite amplification into distortion.

In the case of Vink's original design, as drawn by him in Fig 1, you can see that he realizes a compression circuit (automatic volume control) by means of a D-I-Y compression circuit: a VCA, ENVELOPE FOLLOWER and INVERTER. The VCA is initially set with maximum control voltage so that all the signal is passed. However, the output is fed back through the ENVELOPE FOLLOWER which turns it into a derivative control voltage. This control voltage is then applied inversely (by means of the INVERTER) to the CV input of the VCA to attenuate the signal passage in order to keep the output volume within limits.

Vink was forced to realize the compression circuit with separate modules because there was

no ready-made compressor available in the Sonology studios. In VCV and Eurorack you can see the patch with an available compressor module as in Fig 4.

The signal flow and whether or not the patch is started

From the main Input the signal enters one input of the RINGMODULATOR/MULTIPLIER. Its output goes to the REVERB input. The REVERB output passes through the COMPRESSOR to the DELAY linked to the other RINGMODULATOR/MULTIPLIER input. You will notice that if you set up this patch in VCV nothing happens: it remains deafeningly silent on both outputs of the circuit. This in contrast to patching in Eurorack, which does produce audible results. So why dóes it work with Eurorack?

The RING MODULATOR/MULTIPLIER as an interactive element between EXCITATOR and RESONATOR

The answer lies in the analog world in combination with the RINGMODULATOR/MULTIPLIER. In addition to generating sum and difference frequencies represented in the frequency domain, it behaves in the time domain, viewed in terms of signal amplitude, as a multiplier. Thus nothing can appear at the output of that MULTIPLIER until there is a signal at both inputs: something multiplied by nothing is still nothing.

However, in the real, analogue world, such as from Eurorack, there is always something, for example: *noise or 'leak' from a multiplier input to the multiplier output!* Even if there is still no signal from the DELAY at the other multiplier input, it produces a (minimal) amount of system noise and signal input leakage to the output. That tiny bit is enough to start-up the system.

In the digital, virtual analog, domain there is no such thing as system noise, so the process has to be started. This is done by setting the wet-dry output control of the MULTIPLIER not to 100% wet, but for example between 99-90. The signal that leaks through to the output starts up building the patch. From there a repeating process starts, where each repetition in the MULTIPLIER is multiplied again and again.

Vink's Multiplied Feedback anno 2023

The parameter settings and modulation options are very decisive for the possible sound output to be formed. In the original version, Vink used a tape recorder in which the delay time was determined by the distance of the tape transport path from the recording head to the playback head; this limits the minimum delay time to approximately 100 ms.

This 'long' delay time may explain why Vink's Multiplied Feedback was/is not immediately recognized as a self-oscillating excitator-resonator system. With the short delay times, on the other hand, as can be realized in VCV, for example, this becomes clear because you end up in the pitch domain; then you have arrived at variants of the MSW model.

With the today's knowledge, together with the extensive modulation possibilities in current software and hardware such as in VCV and Eurorack, you can now consider Vink's Multiplied Feedback System as a circuit that was way ahead of its time and already refers to what would come later: the birth of abstract physical modeling principles such as MSW and Karplus-Strong.

Extensions of the basic MFb setup

Variation on the basis Mfb set up you will find in various VCV files. On a YouTube video you can see and hear an extension with a multiple delay demonstrated and explained by 'mr sonology' in the analogue studio of Sonology at the Royal Conservatoire in The Hague.
Keep in mind that if you use complex waveforms for input you can quickly end up in noise because of the repetitive multiplying character. In short: with subtle settings, equally nuanced tweaks and listening patience you can explore Multiplied Feedback best.

VCV patch variants

* The most important settings, tweaks and modulations: input signal VCO/RANDOM/LFO, 'leakage' input to output of the MULTIPLIER, Reverb settings, Delay time and Compressor parameters such as Attack and Release as well as applied modulation settings.
*Also compare the difference between linear and exponential (volt/oct) frequency modulation of the input oscillator.
* At the heart of all patches is a configuration of modules as shown in Figure 3 of the VCV implementation.
* As input for the MFb circuit you will find both VCO, RANDOM or LFO only, but also VCO with RANDOM as modulation source.
* Some patches have an extension in the feedback chain with a high pass filter that can reduce the low frequencies.
* Some patches feature multiple LFO or RANDOM modulation modules.
* Green patch cables refer to audio connections; all other colors indicate modulation connections.
* If a downloaded patch does not give immediate audible results, just wait and see, many of the patches take time to build up.
* Sometimes a patch, at least for me, really doesn't start: you don't see any activity in the display of the compressor module. Download the patch again and the problem is solved, at least it works that way for me; maybe it's my configuration: mac OS Mojave 10.4.6, VCV Rack 2 free and MOTU UltraLite?

Despite all the differences in sound output of the various patch samples, you can clearly hear that they belong to 'the same family'. The Multiplied Feedback model as an identity is responsible for this: however distinctive the sounds may be, they all display a certain familiar acoustic quality. Not surprising, because sound-wise they refer directly to the many physical acoustic sound generators that are based on the self-oscillating excitator-resonator systems.

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Thanks to: Jaap Vink, Hans Kulk, Kees Tazelaar

Sources

Youtube

'mr sonology', demo Multiplied Feedback
https://www.youtube.com/watch?v=X_Bcr_HS9XM

'mr sonology' Jaap Vink's 'Tide' 62-minute version for the Stedelijk Museum
https://www.youtube.com/watch?v=WPAofWG3ybU&t=1734s

Jaap Vink's MFb-studio improvisations/compositions op YouTube

En Dehors'

https://www.youtube.com/watch?v=JlJaj4W7eWA

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Further reading

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