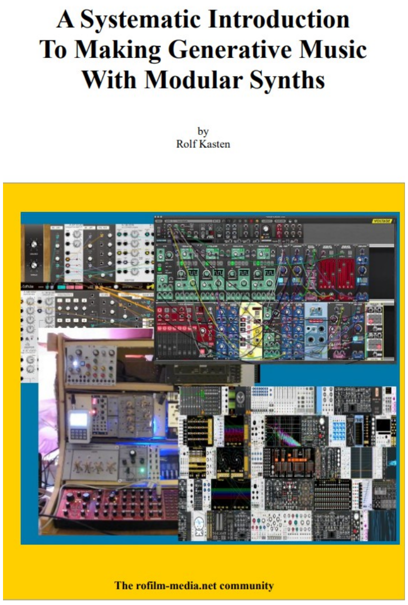
A Systematic Introduction To Making Generative Music With Modular Synths

by Rolf Kasten



Welcome to part 2 of this series of articles taken from the e-book (see https://dev.rofilm-media.net for some background information). Today we start patching, and I have integrated even video in this article to make things audible and visible.

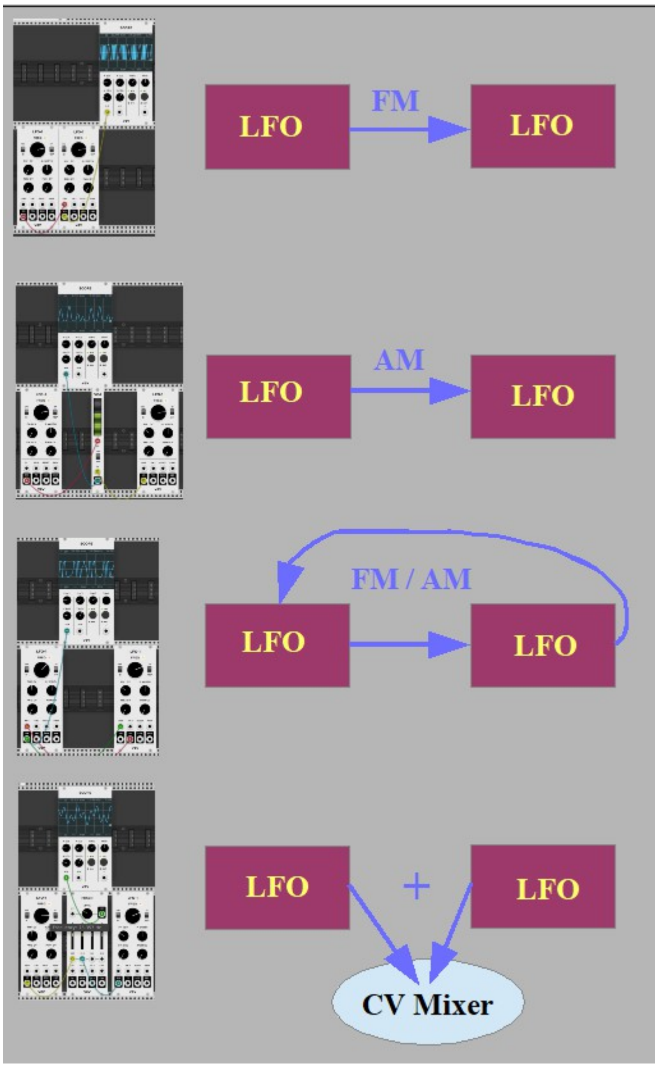
Chapter 1:
Real Randomness vs. Complex Cycles (and the combination of both)

Chapter 1.1:
LFOs

When we hear “permanently changing” most of us will surely think of sample and hold units at first.
And, yes, S&H units are important engines to drive our generative patches. But what about clock generators and LFOs (the latter being able to serve as clock generators as well)?
“Why, LFOs generate regularly repeating cycles?” you may say. And: “No permanently changes will be going on. All changes repeat exactly the same way, when the next LFO-cycle starts.”
You are true. Of course you are. But such LFO cycles can be quite long ones. The lowest frequency of the VCV rack LFO-1 for example is 0.0039 Hz, which means a cycle of 4 minutes and 16 seconds before things start repeating again. And there are LFOs with even lower frequencies and longer cycles out there. But even 4 minutes may give us – as listeners – at

least the illusion of "permanently changing".
Your next argument will be:
"But these changes are going on THAT slowly, that the result is boring at the least, and some of our listeners may even think, that there are no changes at all."
And you are true again. But if my LFO is equipped with a CV-in jack to modulate its frequency, well, then things start to get interesting.

In other words: let´s talk about frequency modulating LFOs, about modulating the modulation strength (the "volume" of an LFO´s output), about feedback loops consisting only of LFOs, and about additive mixing of different LFO outputs.



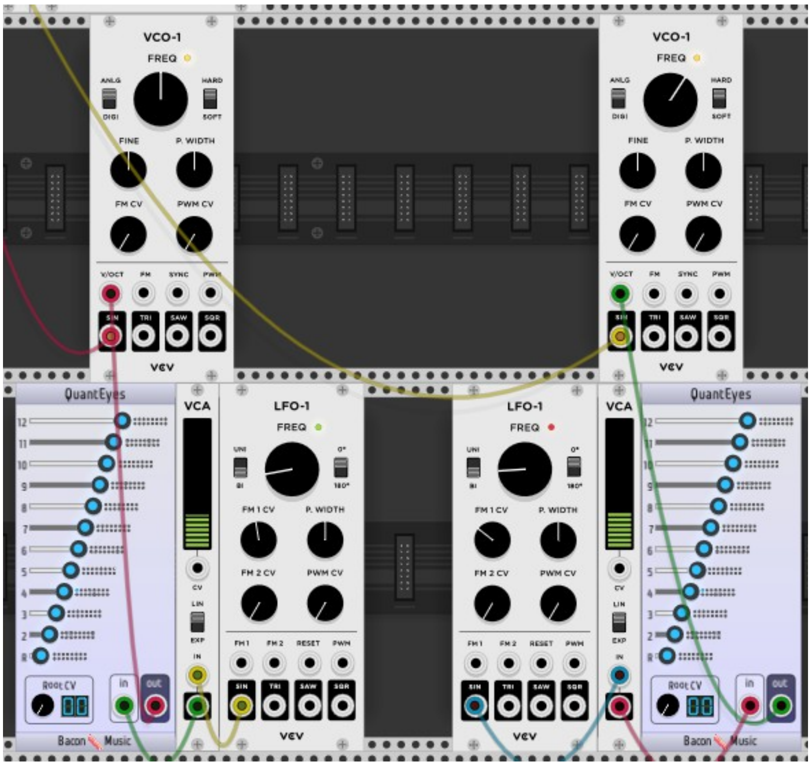
You can imagine what complex networks we can build with these four building blocks.

And if we use different LFOs of such a network to modulate or trigger different sources of sound, we are able to construct a "super-cycle" (which consists of a set of "sub-cycles") that lasts a very long time until it returns to its beginning.

And when we further take into account, that frequency is not the only parameter, which we can modulate, things get really exciting: modulating the LFO´s amplitude, the LFO´s phase and even the LFO´s wave shape (if our LFO is equipped with a CV in jack allowing us to modulate the shape).

A simple example shall explain what I mean:
Let´s take two LFOs, LFO A and LFO B. LFO A runs at a frequency of 0.03 Hz, which is a cycle length of 33 seconds. LFO B runs at 0.04 Hz,

which leads to a cycle length of 25 seconds.
LFO A modulate the frequency of a VCO, let´s call it "VCO X", and LFO B modulates the frequency of a VCO called "VCO Y". We can use two quantisers and two VCAs to make things more comfortable to hear and to listen to.



Let´s now say, that both LFOs start their first cycle at the same time.

To use the aforementioned terms: we have one "super-cycle" consisting of two "sub-cycles".

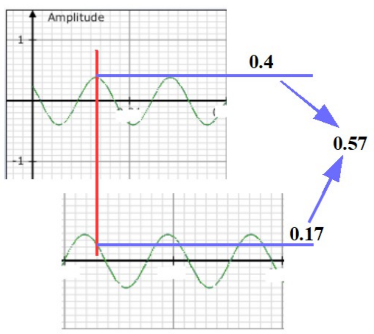
Please look at the following table now: it lasts all in all 825 seconds until both LFOs begin their cycles at the same time again. LFO A needs 25 cycles to get there, and LFO B needs 33 cycles.
The length of our "super-cycle" is 825 seconds, even if the "sub-cycles" are only 25 seconds and 33 seconds long.

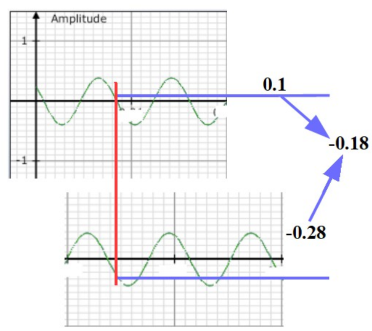
The video "Video C1_1 SupercycleVideo" (just follow the link: https://youtu.be/Y0RFxQf3NZA) demonstrates the patch.

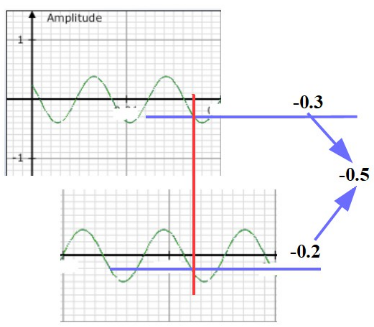
cycles	LFO A (time)	LFO B (time)	cycles
	0	0	
1	33	25	1
2	66	50	2
3	99	75	3
4	132	100	4
5	165	125	5
6	198	150	6
7	231	175	7
8	264	200	8
9	297	225	9
10	330	250	10
11	363	275	11
12	396	300	12
13	429	325	13
14	462	350	14
15	495	375	15
16	528	400	16
17	561	425	17
18	594	450	18
19	627	475	19
20	660	500	20
21	693	525	21
22	726	550	22
23	759	575	23
24	792	600	24
25	825	625	25
26	858	650	26
27	891	675	27
28	924	700	28
29	957	725	29
30	990	750	30
31	1023	775	31
32	1056	800	32
33		825	33
		850	34
		875	35
		900	36

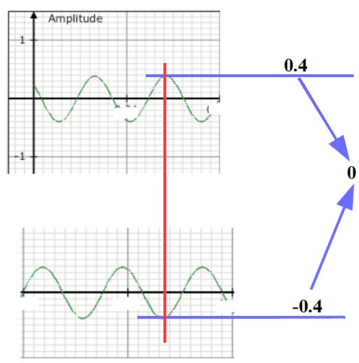
Well then, let´s set up some typical LFO networks now.

The easiest group of LFO networks – easy in terms of predictability – are additive ones, networks in which all LFOs work parallel on one and the same (ore more than one) modulation target. Let me start with 1 VCO as the target and 2 modulating LFOs. In those cases the absolute values of the LFOs add to each other: when the phase of the waves of both LFOs are positive the sum is a higher positive one, if both are negative the sum is a higher negative one, and if one wave is in its positive phase, the other in its negative phase, then we get a subtraction, and in case the waves differ by 180° we get a complete phase cancellation.

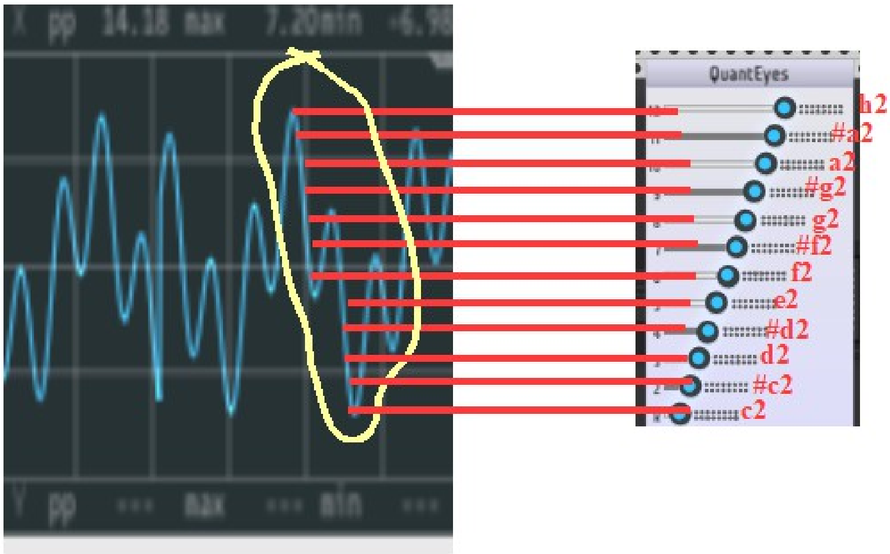








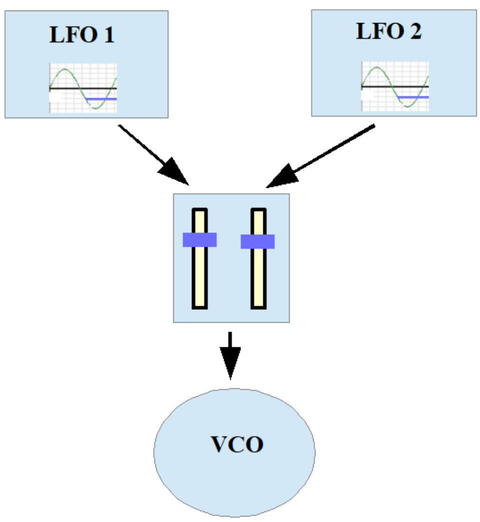
The resulting summing wave may look like in the following picture (just an example). And patching a quantizer between the LFOs and the VCO we get the following melody (given that we have chosen the output strenght of the LFOs adequately (later more about adequate modulation strengths).



In the region marked in yellow the patch will play
h2-#a2-a2-#g2-g-#f2-f2 (will be held for a while given, that the local minimum is still nearer to f2 than to e2) and then continue with #f2-g2-#f2-f2-e2-#d2-d2-#c2-c2#c2-d2-#d2-e2-f2 (will be held for a while again) and then back to e2-#d2-d2-#d2-e2-f2

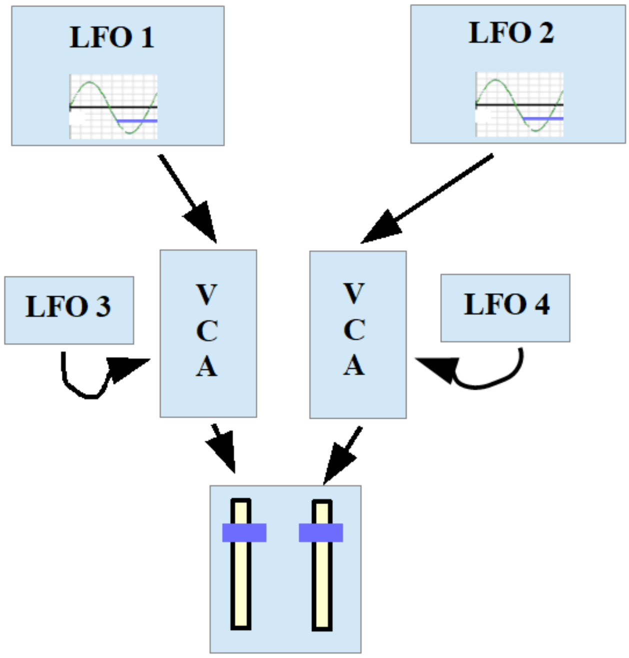
With both LFOs running at different frequencies we get random sounding melodies with patches like that one.

Using a suitable mixer for the two LFOs we can adjust the wanted frequency ranges by adjusting the “volume” of the LFOs – what is adjusting the Cvs, which are sent by the LFOs.



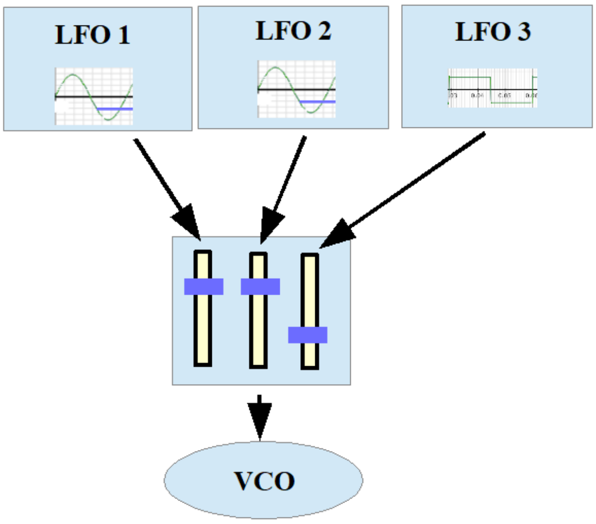
And we can – of course – adjust the LFO output strength differently for both LFOs.

If the channels of our mixer are equipped with CVins, we can modulate the relative strength of each LFO by other modulation sources – e.g. using more LFOs. And if our mixer doesn´t have CV ins, we can patch VCAs between each LFO and the mixer.



But I´m anticipating what will be talked about later.
The following link leads you to a video, which shows me messing around with the patch (and explaining a bit more about it). In the video I´m using other LFO waves than only sine waves as well.
https://youtu.be/ZW3jcsFh0jg

Let me add a third LFO. But instead of just another sine wave this new LFO shall produce a square wave, a wave that simply jumps between two values. We will have to attenuate the output of this LFO a lot to avoid long periods of silence, when it´s at its low level.



With a patch like that we get “unexpected” jumps in the melody, which had been simply going up and down so far – continuously up and down – and the only “randomness” was in the different lengths of the rises and falls.
And with this third LFO, which – or course – runs at a third different frequency, the overall length of the aforementioned “super-cycle” increases dramatically, which increases the impression of randomness even more. With frequencies of 0.025 Hz, 0.035 Hz and 0.25 Hz our “super-cycle” gets a length of 1,160 seconds, what is nearly 20 minutes. Surely long enough to cause the impression of real randomness.
The video, which is hiding behind the following link demonstrates (and explains) the patch in detail.
https://youtu.be/i82oluhKj7M

In the next article I´ll leave the field of purely additive combined LFOs, build up some rather complex networks and introduce a general LFO block system to make it easier to construct and to document LFO networks of infinite complexity.

… to be continued