

Electronic organ: digital precision in the analogue era

Characteristics of the pipeorgan

One: A keyboard instrument in which each key sounds an independent sound generator and continues to sound until the key is released. A dedicated sustained oscillator, in a somewhat more contemporary speak.

Two: One key can be linked to multiple sound generators, stops/ranks. Sounds can thus be stacked and mixed. Especially the mixing of stops with different pitch, usually distinguished in octaves, fifths and to a lesser extent also thirds and other intervals.

This is all done with mechanical technology. Each oscillator (pipe) is *re-started* with each new key press and is *stopped* when the key is released. This yields characteristic perceptual characteristics. The specific attack effect, called 'Spuck' in German and 'chiff' in English. Then, every pipe is tuned as accurately as possible. The octaves in the periodicity ratio from one to two. At that time we believed we could do so: tuning two pipes *exact* in 1 to 2 frequency ratio.

Characteristics of the electronic organ

The oscillators, in this case electronic circuits, were *free running*: constantly in vibration. They started when you turned on the power switch. The keys were on and off switches. Press and hold key: signal connected to the amplifier. Release key: signal disconnected.

12 independent top octave oscillators and frequency dividers

In this system no characteristic phenomena of building up and ending of oscillation. A key activates a characteristic key click, because of signal phase switching in a random order. But even worse, only twelve oscillators were available: for the twelve tones in the highest octave. The other lower octaves were derived by means of frequency division.

Integrated top octave synthesizer chip: tight synced frequency ratios

Digital circuits, binary counters. in short: digital precision in the analogue era. Real tight synced frequency ratios, we only knew from theory.

The originally separate main oscillators were replaced later on by the so-called top octave synthesizer chips. Now we also heard for the first time the mutual relations of the twelve tones approaching equal tempered tuning with digital accuracy.

These instruments certainly couldn't be without bells and whistles: vibrato, (spring) reverberation, percussion and sustain were the least to make it acceptable for the ear.

E-Organ

This patch gives a resounding imitation of an electronic organ based on continually operating oscillators and synced octaves by means of frequency division. In the NMG2 Engine or keyboard version (hardware) this can be

done very simply with just one oscillator.

You don't even need octave dividers to realize those exact octaves. The calculation in the G2 is just as accurate as the operation of the binary counters of yesteryear.

The software G2Demo does not calculate so exactly. You still hear beatings within certain intervals. The basic waveforms in electronic organs were mainly sawtooth and square wave signals. By means of various static filter circuits such as low pass, high pass and band pass, different timbres were realized.

If you mix two such distinct timbres with the same pitch, you don't hear two sound sources, but only one source with a new different timbre. The E-Organ patch consists of four identical stops supplemented with one Lfo for global vibrato.

Furthermore, each stop can be provided with percussion and sustain. Sustain is organ speak for a decaying tone after releasing a key. In synth terms we would call this release. Percussion, on the other hand, is decaying while the key is held down. So in synthesis speak decay.

Ernst Bonis

This article was originally published in Dutch as 'Digitale precisie in het analoge tijdperk, elektronisch' in Interface 118 May 2008.

Literature

servicing electronic organs
by Carl R. Pittman and Eugene J. Oliver
Howard W. Sams & Co., Inc.
Indianapolis * New York 1962
Library of Congress Card Number: 62-17623

Die elektronische Orgel
Michael Rieländer
Schriftenreihe Das Musikinstrument, Heft 15
Verlag Das Musikinstrument
Frankfurt am Main
ISBN 392 0112 482

Internet

https://en.wikipedia.org/wiki/Electric_organ