Creating good digital Organ sounds using Yoshimi synthesizer

Part 1

1.
Paul Nasca said Wed Sep 08, 2004 9:00 pm
https://www.kvraudio.com/forum/viewtopic.php?t=55611

I wish to add to zynaddsubfx a organ module and I wish that the user interface to that organ synth to be like on the organs (eg. to use the stops,etc).
Even if now it is possible to do NOW some organ sounds, I think that using stops and other organ-like setting would be great.
Also, I am interested in doing "stops" synthesizer (eg. to be able to "parametrize" the stops, i.e. to synthesize most of the stops that exists by simple parameters (and allow the user to add custom stops)).
Well, I didn't study the pipe organ too much, so I need suggestions, stops samples,etc. Also I want to do it all by synthesis and not by samples (eg. not by loading a soundfont).
Now I am in the "study" phase, and after this, I want to start to implement this.
So, what would you like to behave the zynaddsubfx organ?
IMO, the building blocks exists already in zynaddsubfx (the Oscillator that allows any waveform, envlopes, etc).

2.
Good Organ Sound Basics:
http://zynaddsubfx.sourceforge.net/doc_0.html
This doc is worth reading. The writer says eg:
I am not referring to samplerate, I am talking about the frequency "spread" of each harmonic. This is the most important principle of making instruments that sound good.
Often it is believed that the pitched sounds (like piano,organ,choir,etc.) for a single note have a frequency, it's actually harmonics and nothing more. Many people try to synthesize a sound using an exact frequency+harmonics and observe that the result sounds too "artificial". They might try to modify the harmonic content, add a vibrato, tremolo, but even that doesn't sounds "warm" enough. The reason is that the natural sounds don't produce an exact periodic; their sounds are quasi-periodic. Please notice that not all quasi-periodic sounds are "warm" or pleasant.

Simple demo:
http://zynaddsubfx.sourceforge.net/example01.ogg

3.
My personal project page:
https://sites.google.com/site/reinourala/-b3-saehkoeurku

Part 2

In 2004 Paul Nasca called for a Yoshimi “stops syntethiser”, which would be a high quality electronic organ.
Paul Nasca’s synthesizer is great for a wide variety of sound synthesis. Surprisingly it is also suits well for building a digital Organ:

- Multiple Part’s for multiple drawbars (stops)
- Separate filters and effects for all part’s
- Many global effects and part’s effects (reverb, chorus, phaser, etc)
- Clean waveforms. E.g. clean sinus waveforms for Vintage Hammond sounds
- IFFT for simply deployed warm sounds (PADsynth)
- Separately controllable multiple voices (up to 8 voices) (ADDsynth)
- Amplitude envelope control
- Frequency envelope control
- Sound wave starting effects manipulation

Main focus of this project is a sinus synthesis organ.

Yoshimi is capable using many other generator wave forms too, but best electronic organ sounds can be created using a fundamental sinus synthesis. However Yoshimi’s “power”-waveform is adopted for certain special needs.

There would be two ways to go:

- Creating a good sounding organ from scratch
- Cloning a Vintage Hammond B3

This project starts “from scratch”. All new Yoshimi’s good sound ideas are applied:

- To create well sounding quasi periodic organ sounds.
- To add new interesting sounds and effects.
- To obsolete rotating speakers (Leslie).

Yoshimi could, of course, be used to clone a Vintage Hammond, but this would be vaste of Yoshimi’s great good sound tools.

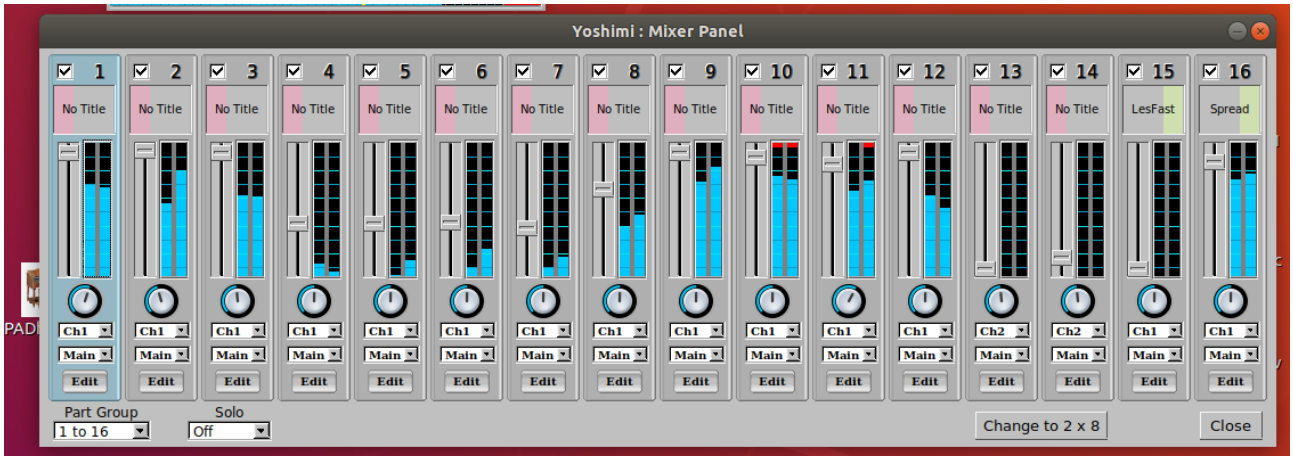
But, there are plenty of good sound considerations to learn from Vintage Hammonds.
Good Vintage Hammond sound cociderations are summed, for reference, separately in this report. check Part 4.

Drawbars and / or stops:

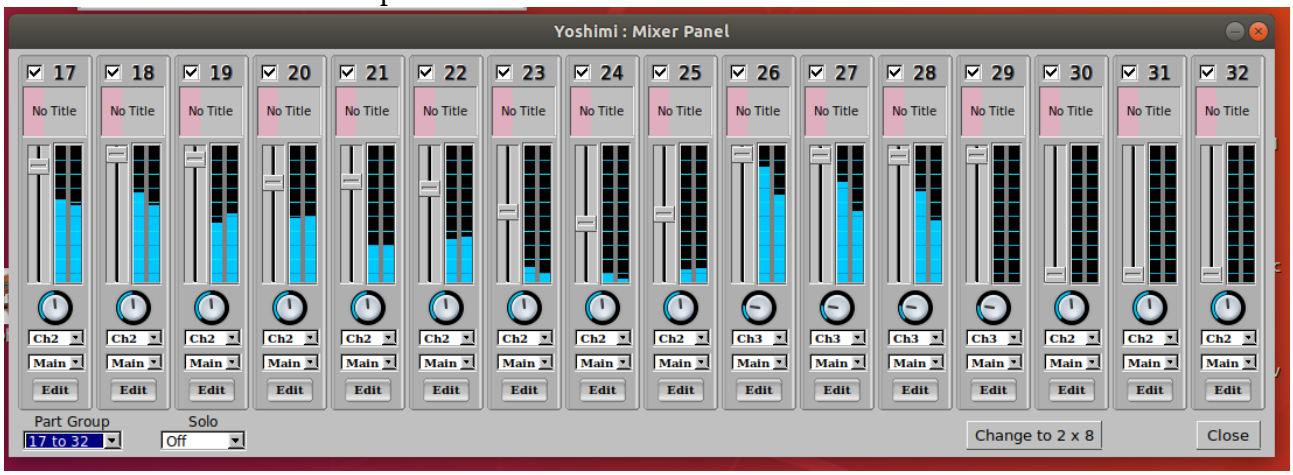
This information is to be developed further. Today’s project:

Drawbar’s are Part’s in Yoshimi:

Parts 1 to 9 =Upper manual Drawbars 16’ 8’ 5 1/3’ 4’ 2 2/3’ 2’ 1’ 1 3/5’ 1/3’ 1’
Part’s 10 and 11 =Upper manual Drawbars percussion 2’ and 2 2/3’
Part 12 = Upper manual Drawbar “key click”
Part’s 13, 14, 15 =Free
Part 16 =Wide spectrum effect / IFFT



Parts 17 to 25 =Lowerer manual Drawbars 16’ 8’ 5 1/3’ 4’ 2 2/3’ 2’ 1’ 1 3/5’ 1/3’ 1’
Part’s 26 and 27 =Bass pedals Drawbars 32’ 16’
Part 28 = Bass pedals Drawbar “key click”
Part’s 29, 30, 31 =Free
Part 32 =Lower manual “complex wheels” bass



Using multiple voices for warm sound (ADD-synth):

Multiple simultaneous voices:

ADD-synth's multiple voices (up to 8 pcs) can be individually manipulated (slight detuning, panning, vibrato, etc …). That is = Warm sounds.

Percussion:

Sinus synthesis organs adopt percussion. This is "piano style" sounds attack effects, typically guided only to certain drawbar channels. Typically to drawbar channels 2 ' and 2 2/3'. When using Zyn or Yoshimi, it is a good idea to reserve some Part's for percussion only.

Key-click:

Vintage Hammond interesting "key-click" story is described later in Part 4.

In Yoshimi organ, the voices start manipulation possibilities are wide: Short noise pulses sounds good as a controllable key click. Yoshimi's "punch" effect may be used as well?

Imagine, additionally, flute and organ pipe sound wake up effects.

It is a good idea to reserve some Part's for different voices starting phenomena control.

IFFT:

IFFT (PADsynth) and a wide variety of waveforms are tools to create church organ sounds. Preset sounds of this type can be easily adopted. As a simple example church instrument, check in Yoshimi instruments bank organ / 39 / church organ, it is a good idea to reserve some Part's for key-click only. In Zyn and Yoshimi, short noise pulses can be used. Or "punch strength" can be used. Also just boosting high frequencies in Part channels is a good idea. Hammond enhusiaststs did this trick in theis instruments.

PAD-synh is an incredible way to "spectrum spread" warm sounds, by turning just one "spead" button.

Bass pedals power sound:

Yoshimi "power waveform" is like the sound of reed pipe sounds in pipe organs. Very low frequency sinus waves lose their power, as one can't hear low frequency sinus or flute waves. Fundamental low frequency of a sound waves filtered out of unsymmetrical saw waveforms are non heard either, but higher order harmonics create an illusion of really low sounds indeed. The same fact can be learned with pipe organs: Low freq flute pipes can not be hard, but the

reed pipes “complex-wheels” sound is very powerful, and we hear an illusion of really low freq fundamental sound wave.

Presets:
Laptop touch-screen icons are used as sound presets. This type preset can store everything ever vanted. For instance sounds and effects of all keyboards and pedalboard.

Drawbars frequency profile:
This is similar to Vintage Hammond “resistor wires”. This can be applied specifying filters to Part’s = Drawbars.

Overdrive:
Yoshimi has an effect called overdrive.

Part 3

Some pros and cons:

Yoshimi’s synthetiser type windows and buttons hell may be a pain in ass.

The synthesizer type Paul Nasca tool may be headache for an organ designer. There are tens of Windows in the GUI, and every window has hunded of buttons and click-boxes. All these are now not needed. Perhaps that “organ module” suggested by Paul Nasca would make the organ designer worl much simpler?

Typically 8 voices for all 32 part’s means 8*32 edits. And additionally every single block said here may require several additional settings. Alltogether:

This is a job of hours and hours – for one preset sound only.

MIDI velocity:

MIDI velocity command may be a headache when creating organ sounds. As default, there are tons of velocity settings on, and of these should be turned off. Additionally, some heavy edits may very well turn back these defaults, and all the show starts oves.

Plenty of Part’s are useful:

Parts = multiple Drawbars for Hammond style sinus synthesis – or multiple stops for catedral organs. Zyn’s 16 Parts may fall short, but Yoshimi has 64 available parts. Great!

Built console organ using an Yoshimi motor:

My project digiOrgan, built using Yoshimi, MIDI-keyboards plus MIDI-controls, sounds great. I'm playing it every day. But is it completed - never? A 25 key Viscount midi bass pedal board is adopted.

No rotator Leslie is needed when playing this Yoshimi-organ. I'm using either a multiple slightly detuned multiple partial sound technique, or a IFFT technique. Both techniques offer warm and great sounds. Created additionally a powerful brumming, low frequency, bass sound using a "power waveform" plus low pass filtering. For lower keyboard bass theme playing and for foot pedals bass playing.

Pipe organ sounds:

IFFT (PADsynth) and a wide variety of waveforms are tools to create church organ sounds. Preset sounds of this type can be easily adopted. As a simple example church instrument, check in Yoshimi instruments bank organ / 39 / church organ3

Part 4

Vintage Hammond B3 considerations:

Vintage Hammond B3 was developed for 50 years, and it is still a well sounding organ. A rotary speaker system is essential for pleasant Hammond sounds. The heavy weight organ and the essential heavy weight rotary speaker system are a pain for professional musicians.

Viscount Legend and **Crumar** Mojo XT are famous light weight Hammond electronic clones. The **VB3-2** Windows software is a Hammond-clone software, which is actually a "motor" inside the Crumar hardware clone.

Organ cloners cloned about everything regarding sound quality and drawbars plus buttons types and locations. Also Hammond B3 disfunctions, as sounds cross-talk and leakage are cloned. **It is a good idea to download the Windows clone software VB3-2 for 125€ to study Vintage Hammond B3 peculiarities:**

1. High sound frequency (1kHz and up) enhancement (up to 10...15 dB):
Especially jazz organists prefer high-frequency screaming sound when moving hands up in keyboards. The high-frequency boost is made later in tone-wheel Hanmmonds and in all of the clones as well. Some Vintage Hammond users added switches to select hi-freq enhancement on/off.

2. High frequency fold-back:
As Hammond Tone Generators highest frequency is 5900 Hz (F#), uppest keys drawbars missing frequencies are replaced by fold-back'ing lower ones. The fold-back replacement signals are attenuated app. 9 dB.
For instance: After F# = 5900 Hz the next G frequency should in principle be 6251Hz, but it is, when fold-back'ed, in practice half of that = 3125 Hz. The fold-back signal level is attenuated app. 9 dB.

3. 16' fold-back:
Playing low frequency notes 32Hz … 64 Hz using keyboards 16' drawbars is a challenge. For instance jazz organists often are playing bass themes using the lower keyboard. But Low notes 32 … 64 Hz sinus sounds are too low to get out of normal amplifiers and speakers.. Hammond adopted a 16' drawbar fold-back: Lowest octave 16' sounds are repeated from the second octave. This way the jazz organists may play audible bass accompaniment for instance at two lowest octavest octaves of the lower keyboard.

4. Resistor wires:
Hammond uses “resistor wires” for connecting Tone Generator signals to different drawbar channels. This way every drawbar signal level is trimmed according to frequency. For instance 16’ 5 1/3’ and 8’ signals are slightly attenuated toward low frequencies, and 2’ and 1 3/5’ and 1 1/3’ signals are slightly attenuated toward high frequencies. These resistor wires signal level trimming magnitudes are small.
You may experiment the resistor wires effect using the VB3-2 clone software. Heaviest trims appear to fall less than 3 dB.

5. Phase vibrato and Chorus:
Hammond created a great phase vibrato to get rid of the artificial sound of a pure sinus synthesis. However, this great effect in practice never totally replaced the rotating Speakers cabinet sound.

6. Key Click :
Very early Hammonds had an “annoying key click”, that was later reduced by adopting a certain generator output voltage pre-emphasis and a corresponding frequency band hi-freq filtering in pre-amp. Jazz organists, however, found the key-click versions sound better, and they removed the pre-amp filtering. This history relates to the hi-freq enhancement, said in paragraph 1.

7. Complex bass wheels:
The Vintage Hammond B3 is a sinus-wave-synthesis organ. But there is one exception: Instead of sinus wheels, there are “complex-wheels” to create bass pedals signals. The complex-wheels sound is like the sound of reed pipe sounds in pipe organs. Very low frequency sinus waves lose their power, as one can’t hear low freq sinus or flute waves. Fundamental low frequency of a sound waves filtered out of unsymmetrical saw waveforms are non heard either, but higher order harmonics create an illusion of really low sounds indeed. The same fact can be learned with pipe organs: Low freq flute pipes can not be hard, but the reed pipes “complex-wheels” sound is very powerful, and we hear an illusion of really low freq fundamental sound wave.

8. Percussion 2’ and 2 2/3’:
Early Vintage Hammonds did no adopt percussion at all. But jazz musicians called for percusion, and it was was added to organ models B3, C3 A-100 and up.
Percussion was added without adding drawbar wires to 9 pcs of key contacts, but it was triggered by 1’ drawbar signal, and 2’ and 2 2/3’ drawbar percussion signals were lead to a separate attack-amplitude-peaking circuit.

The percussion effect only triggers, when the fist key is pressed. If one plays “legato”, there is no percussion. Jazz players like it this way, as they prefer percussion only at certain attack points, but they can play “legato” elsewhere. Only professional players are routined to use percussion attack this way. Less experienced players may play percussion attack’s in wrong places too.

9. Presets:
Vintage Hammond adopted “inverted color” keyboards left octave as presets. These are drawbars settings presets. Nothing more. You can’t store effects, percussions,or vibratos to preset keys.

10. Overdrive:
Overdrive is signal soft clipping in vacuum tubes. Rough effet – used sometimes in rock music.

11. Reverb:
Not applied.