Krzysztof Gawlas
Institute of Music, Artistic Department, University of Silesia in Katowice

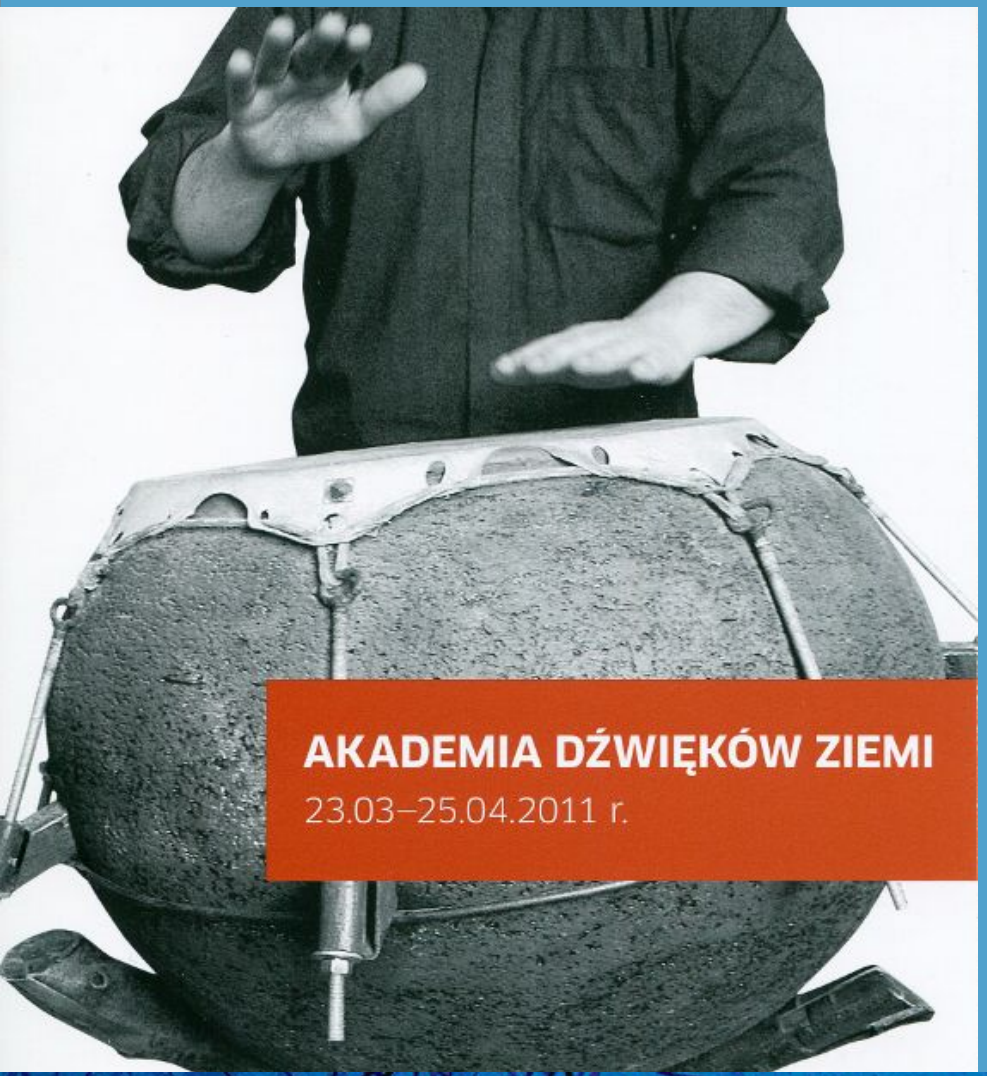
Rite of the Earth

composition with frequency-based harmony and ambisonic sound projection.

LAC 2012, CCRMA Stanford

Academy of the Sounds of the Earth

Institute of Fine Arts, Artistic Department, University of Silesia in Katowice



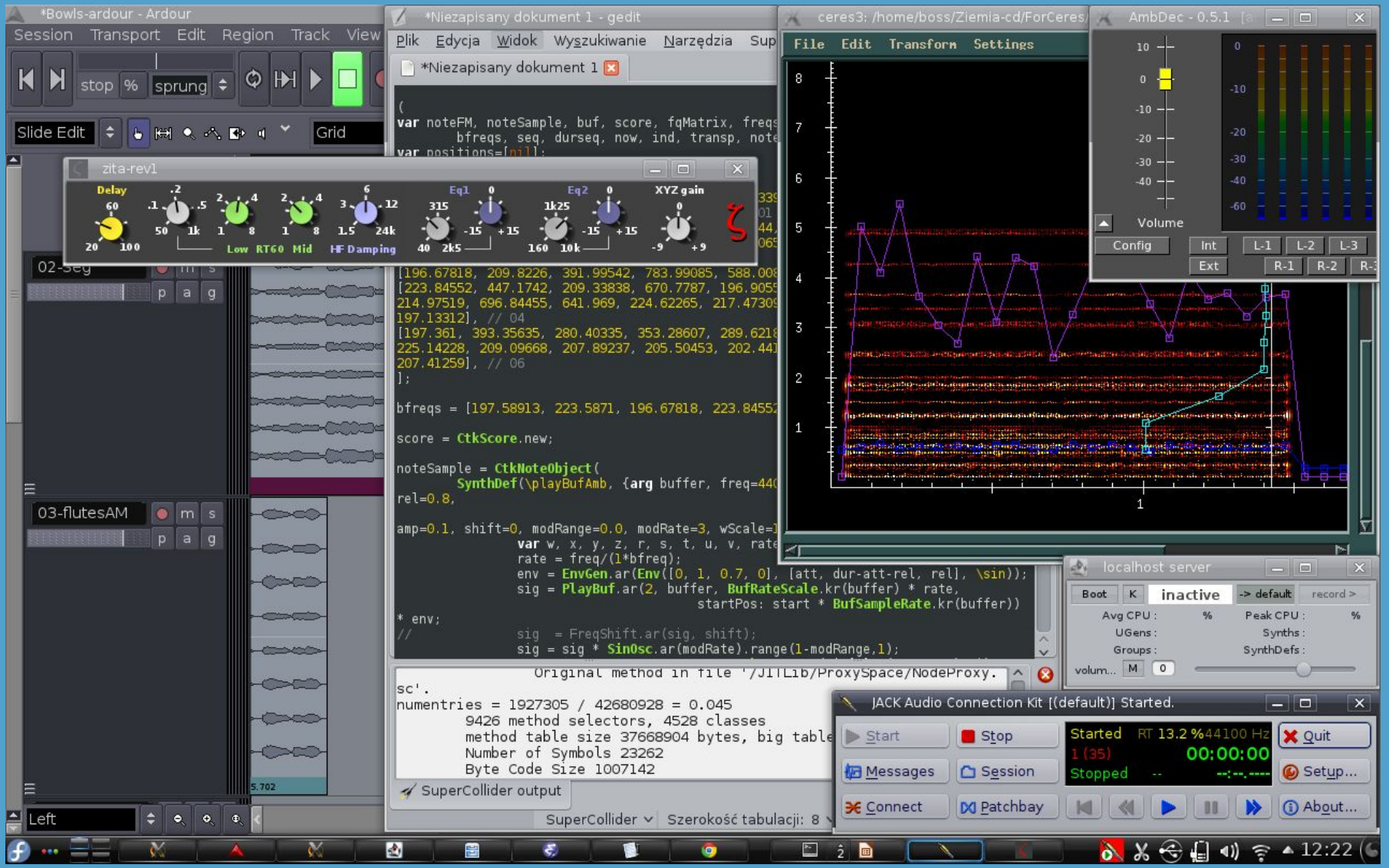
- Since 2007
- Artistic director – dr hab. Małgorzata Skałuba-Krentowicz
- Lecturers and students of the Institute of Fine Arts and students of Ethnology
- Over 70 different instruments
- Several exhibitions and concerts

Example instruments

- Trial and error approach of instrument building
- Focus on visual side
- Very soft sound, too soft for an acoustic concert
- Tuning of the instruments doesn't correspond to any particular musical scale

On the other hand...

- Interesting sounds
- Great sound material for computer treatment
- Timbral structures inspiring for harmonic operations challenge



Recording of the sounds

2 methods:

- B-format with 1 omnidirectional and 2 figure-of-eight microphones
- a-b – 2 spaced omnidirectional microphones

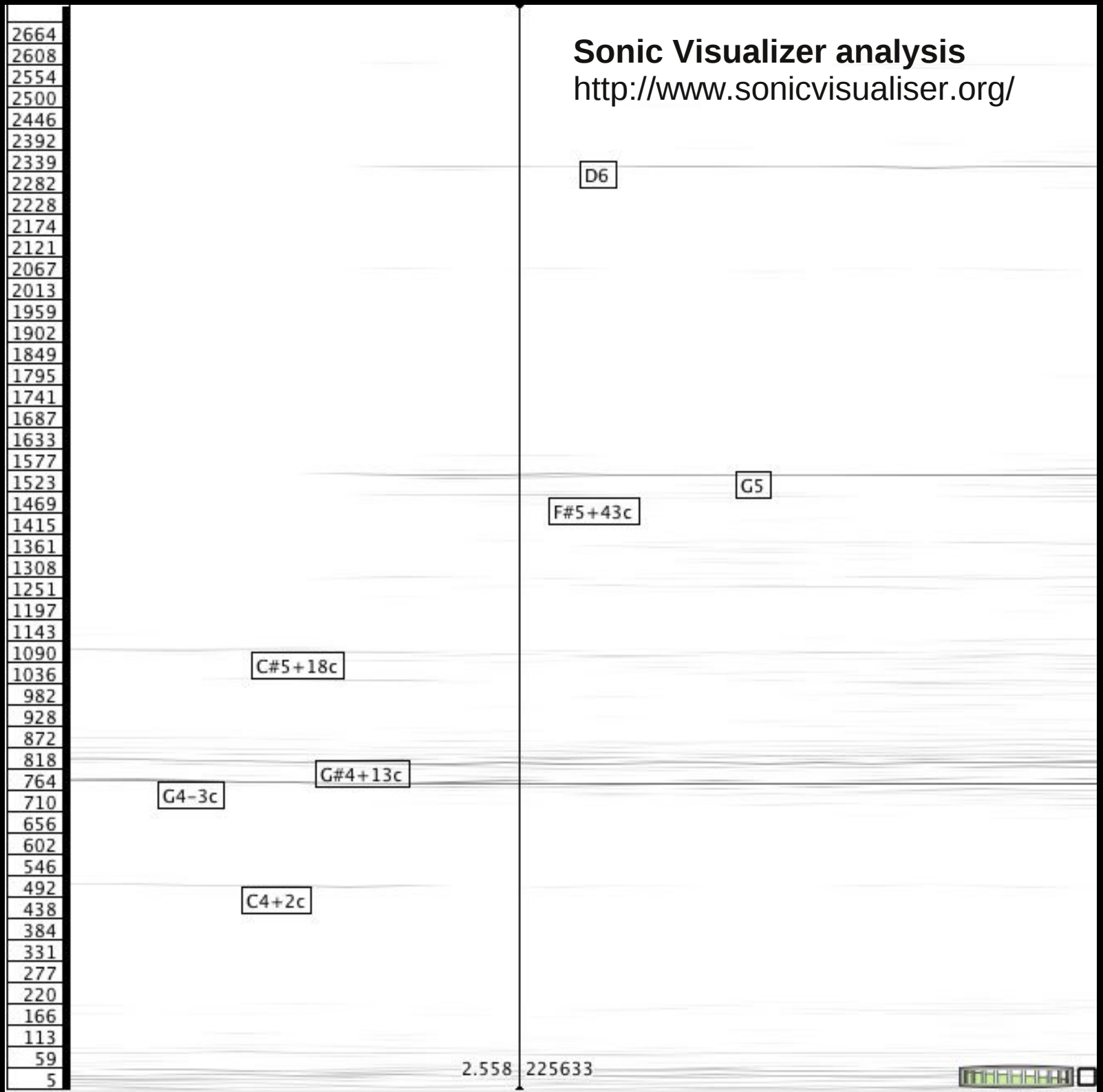
Analysis of the sounds

Spectral analysis for studying the inner structure of the sounds

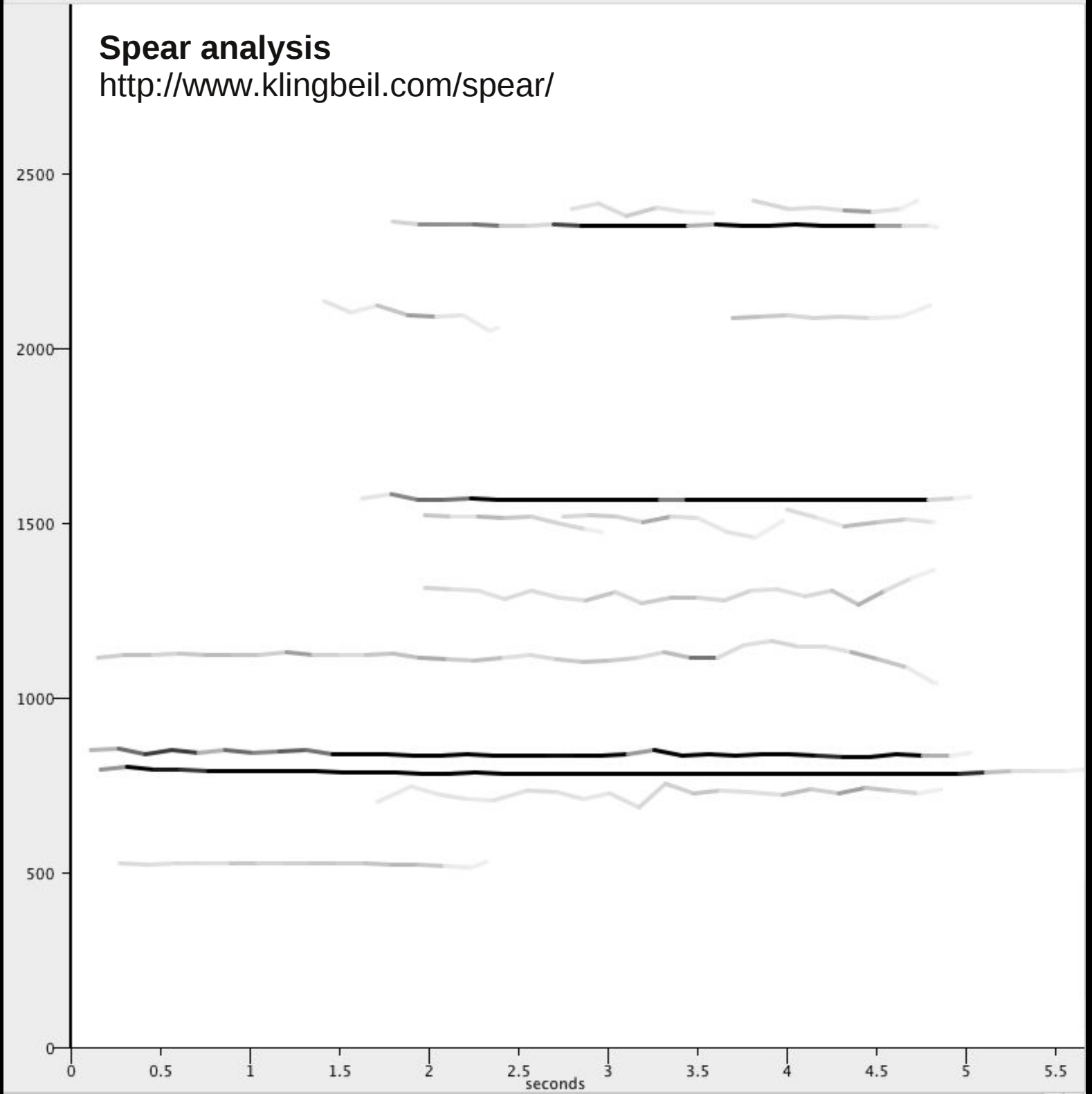
Export to musical notation

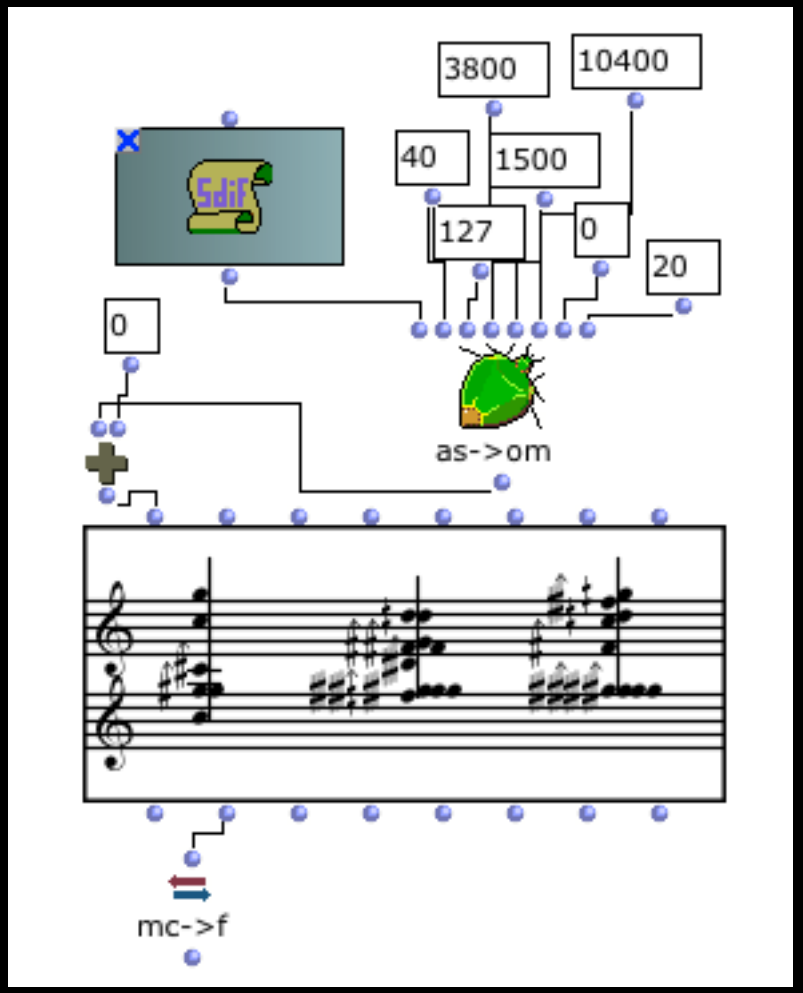
Timbre-harmony unity

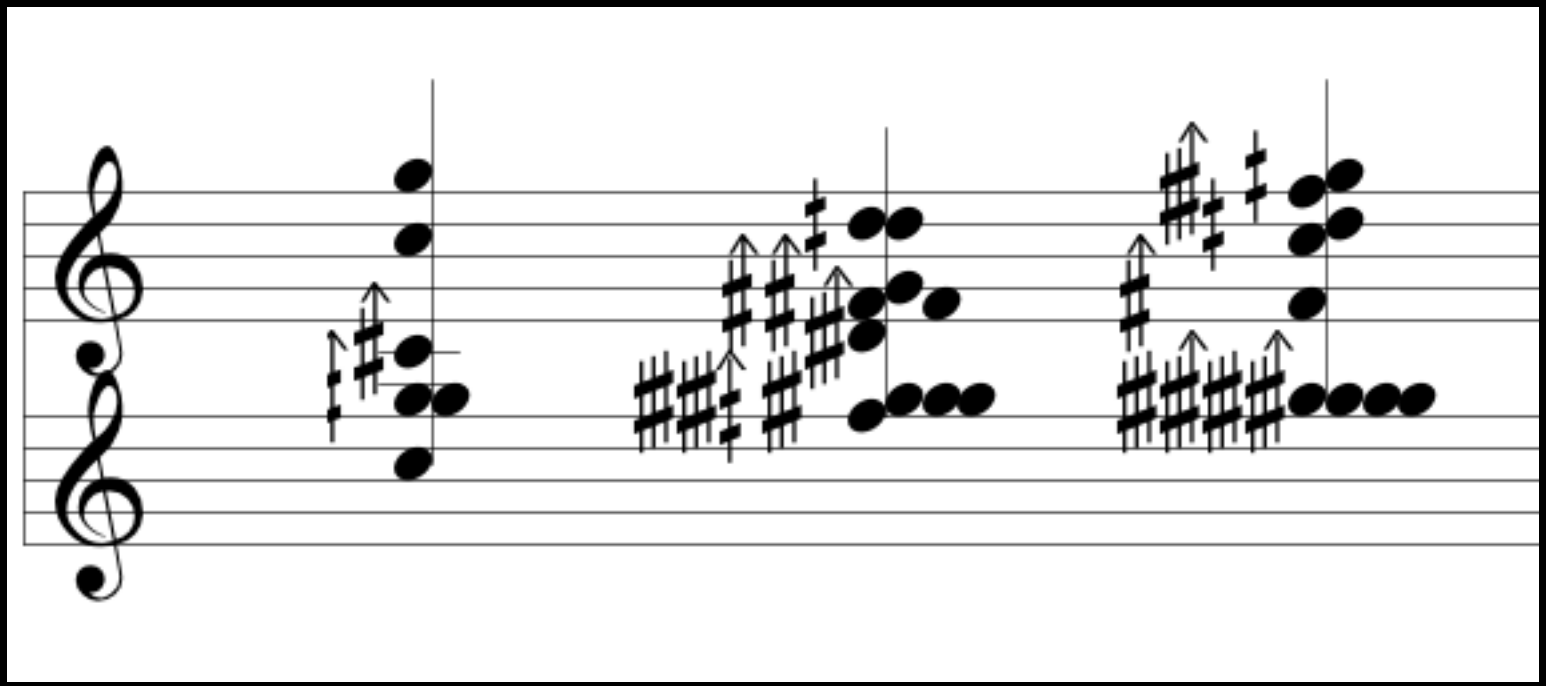
Musical discourse through transformation of chord structures

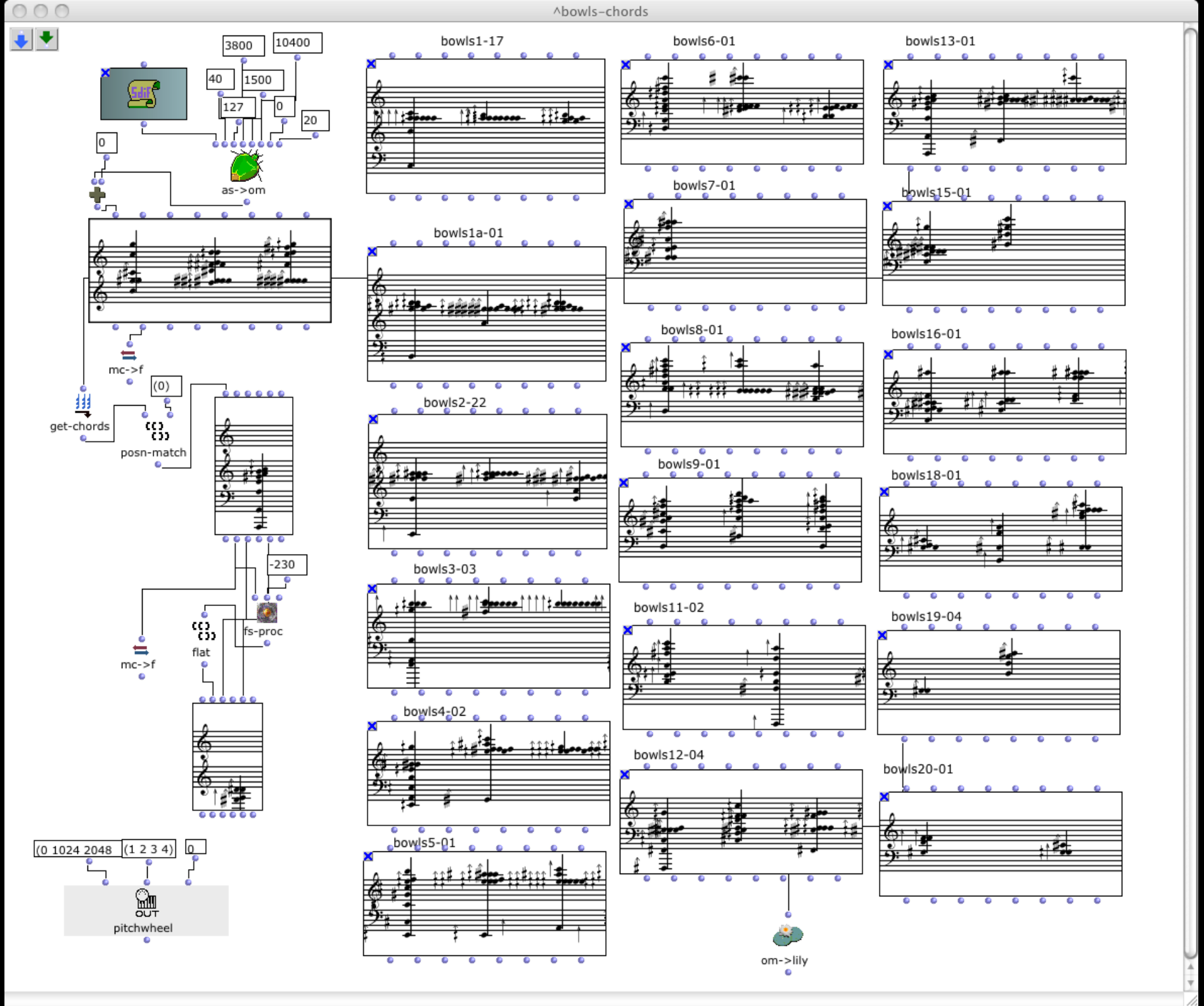

Sonic Visualizer analysis
http://www.sonicvisualiser.org/
2664
2608
2554
2500
2446
2392
2339
2282
2228
2174
2121
2067
2013
1959
1902
1849
1795
1741
1687
1633
1577
1523
1469
1415
1361
1308
1251
1197
1143
1090
1036
982
928
872
818
764
710
656
602
546
492
438
384
331
277
220
166
113
59
5
D6
G5
F#5+43c
C#5+18c
G#4+13c
G4-3c
C4+2c
2.558 225633

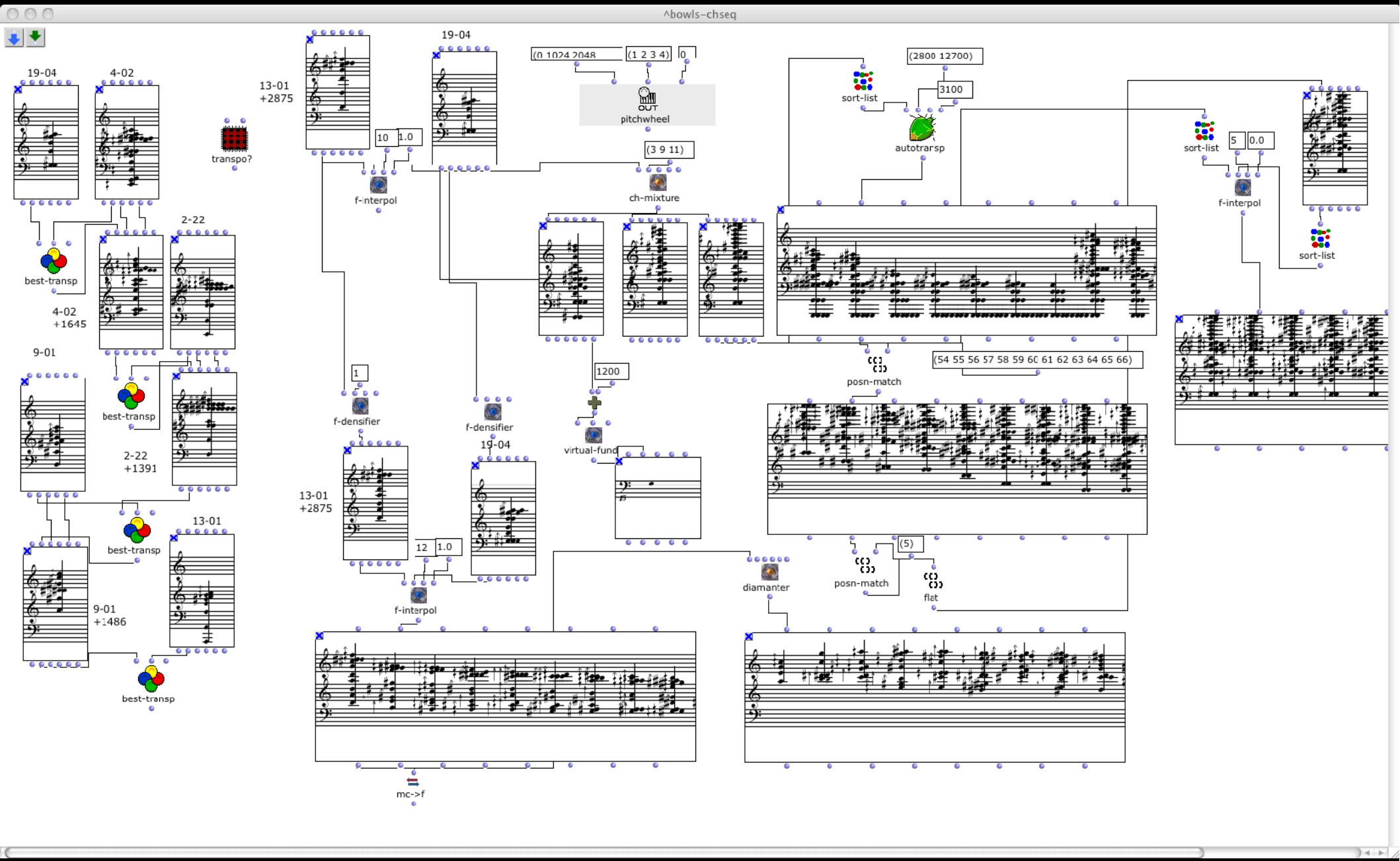
Spear analysis
http://www.klingbeil.com/spear/




3800
10400
40
1500
127
0
20
0
as->om
mc->f




^bowls-chords
3800
10400
40
1500
127
0
20
0
as->om
mc->f
(0)
get-chords
posn-match
-230
fs-proc
flat
mc->f
(0 1024 2048
(1 2 3 4)
0
OUT
pitchwheel
bowls1-17
bowls1a-01
bowls2-22
bowls3-03
bowls4-02
bowls5-01
bowls6-01
bowls7-01
bowls8-01
bowls9-01
bowls11-02
bowls12-04
om->lily
bowls13-01
bowls15-01
bowls16-01
bowls18-01
bowls19-04
bowls20-01


^bowls-chseq
19-04
4-02
transpo?
best-transp
4-02
+1645
2-22
9-01
best-transp
2-22
+1391
best-transp
13-01
9-01
+1486
best-transp
13-01
+2875
19-04
10
1.0
f-interpol
(0 1024 2048
(1 2 3 4)
0
OUT
pitchwheel
(3 9 11)
ch-mixture
1
f-densifier
f-densifier
1200
virtual-fund
19-04
13-01
+2875
12
1.0
f-interpol
mc->f
sort-list
(2800 12700)
3100
autotrarsp
posn-match
(54 55 56 57 58 59 60 61 62 63 64 65 66)
(5)
posn-match
flat
diamanter
sort-list
5
0.0
f-interpol
sort-list

OpenMusic -> SuperCollider

OM uses midicents for pitch

Middle C=60 in MIDI so it's 6000 in midicents

One can easily and with high accuracy convert it back to frequency

Chords were imported as arrays of frequencies in sc

Generating musical gestures

Strenghts of Supercollider – combining powerful synthesis engine with flexible control possibilities – envelopes, various random distributions, tendency, routines, patterns...

Ctk - The Composition Tool Kit

by Josh Parmenter (DXARTS)

A set of Supercollider Object classes for creation of fixed pieces through the use of a Score-like structure.

Replacement for the standard SuperCollider classes (Synth, Buffer, Group, and Bus), that can be used in RT and NRT synthesis without changing the syntax.

Problems with the Ctk method

Not all processes may be wrapped into the Ctk system – for example:

- PmonoArtic – patterns that play legato instruments (changing pitch of a sounding note instead of playing several consecutive notes)
- BBCut (a library for algorithmic beat slicing)
- Realtime controllers use

In above cases SuperCollider was used in realtime and its output was connected through jack directly to Ardour.

Instruments

Sampling

Sampling and frequency shifting or ring modulation

Hybrid – sample + additive or FM synthesis

Resonance models + samples as exciters

Ats resynthesis with complex instruments instead of sinusoids

Granular synthesis

BBCut for rhythm slicing

```
SynthDef(\playBufAmb, {arg buffer, freq=440, bfreq=440, dur, att=0.01,
                        rel=0.4, start, pan=0, rho=1, amp=0.1,
                        shift=0, wScale=1;

    var w, x, y, z, rate, sig, env;

    rate = Lag2.kr(freq/(1*bfreq), 0.03);

    env = EnvGen.ar(Env([0, 1, 0.9, 0], [att, dur-att-rel, rel], \sin));

    #w,x,y,z = PlayBuf.ar(4, buffer, BufRateScale.kr(buffer) * rate,
              startPos: start * BufSampleRate.kr(buffer)) * env * amp;

    #w,x,y,z = FreqShift.ar([w, x, y, z], shift);

    #w,x,y,z = BFManipulate.ar(w, x, y, z, pan);

Out.ar(0, [w*wScale, x, y, w]);
})
```

```
// thisThread.randSeed_(171); // SEEDS
repeats=16;
repeats.do({|ix|
 var ind, freqs, pans, offset, durEnv, toffsEnv;
 ind=[0,1,2,4,11,12,13].choose; //buf.size.rand;
 freqs=(intplMatrix[1]);
 offset=ix;
 durEnv=Env([1.0,0.3],[1],\lin);
 toffsEnv=Env([0,33],[1],-1);

 if (0.9.coin, {
  score.add(noteSample.note(toffsEnv[ix/repeats], 14.5)
     .buffer_(buf[ind])
     .freq_(CtkControl.env(
         Env([freqs[0+offset], freqs[0+offset],
              freqs[1+offset], freqs[1+offset],
              freqs[2+offset], freqs[2+offset],
              freqs[3+offset], freqs[3+offset],
              freqs[4+offset], freqs[4+offset]],
         [0.25,0.0,0.25,0.0,0.25,0.0,0.25,0.0,0.25]*durEnv[ix/repeats], \lin)))
     .bfreq_(bfreqs[ind])
     .shift_([(freqs[4+offset]/[0.5,0.25].choose).neg, 0].choose)
     .dur_(rrand(12.5,14.5))
     .start_(0.0)
     .amp_(rrand(0.1,0.4))
     .wScale_(CtkControl.env(Env([-20.dbamp,0.dbamp,-20.dbamp], [3.5,5], \sin)))
     .pan_(pi.rand2))},
  {});
});

score.play;
// score.write("/home/boss/Ziemia-cd/Bowls&Bows/Intpl2-8-wxyw.wav".standardizePath,
//  options: ServerOptions.new.numOutputBusChannels_(4));
)
```

Spatializing and mixing

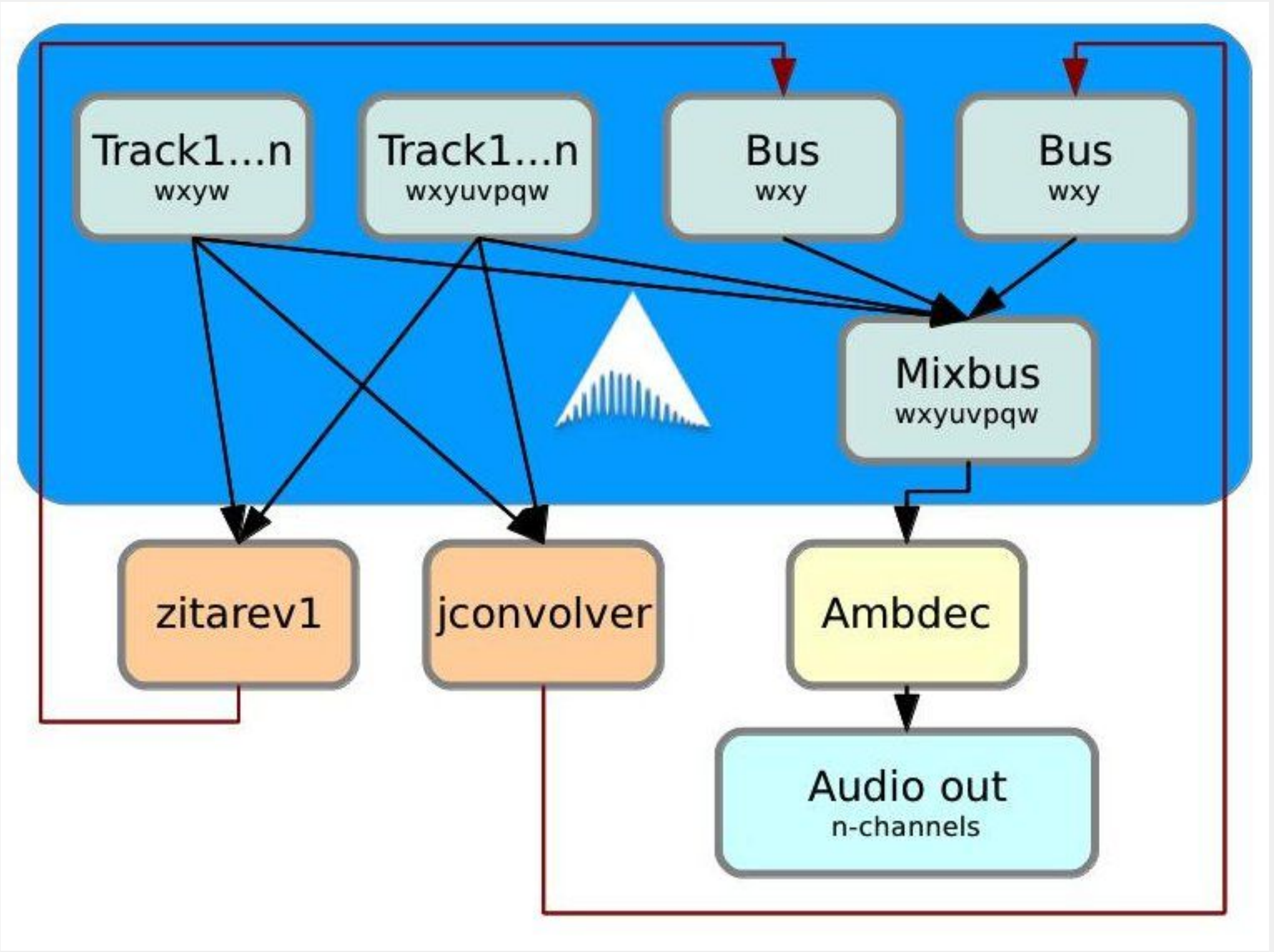
The soundfiles generated in SuperCollider are already multichannel, 1-3 order ambisonics.

Micro-scale (notes) positioning/movements was done in sc.

Medium-scale spatial arrangement in DAW.

Distance changes through “w” signal gain modulation. Unmodulated “w” signal for feeding reverb. The soudfiles generated in Supercollider contain “modulated w”, “x”, “y” (...) and “unmodulated w” signals.


Drummers-ardour - Mixer - Ardour
02-drums
03-delayFX
rev-submix
amb-mix
amb-mix2
master
Record
>send 1
>send 2
Virtual stereo
Mute
Solo
Grp
post
link
Comments
amb-mi
zita-r
zita-d
ambdec
1/2
AmbDec - 0.5.1
Volume
Config
Int
Ext
L-1
L-2
L-3
R-1
R-2
R-3
Eq1
Eq2
XYZ gain
Low RT60
Mid
HF Damping
jkmeter jkmeter-0.6.1
LU
-2.1 LU
LRA : 11.7 LU
Threshold
Release
12.6 dB
-1.3 dB
10.0 ms
Start
Stop
Started RT 3.8 % 44100 Hz
0 (0)
Stopped
00:00:00
Quit
Messages
Session
Setup...
Connect
Patchbay
About...
AmbDec - 0.
Ardour
Dolphin
ebumeter -
jkmeter
Konsole
JACK Audio
zita-dpl1
zita-rev1
10:14


Track1...n
wxyw
Track1...n
wxyuvpqw
Bus
wxy
Bus
wxy
Mixbus
wxyuvpqw
zitarev1
jconvolver
Ambdec
Audio out
n-channels

Acknowledgments

Akademia dźwięków ziemi (Academy of the Sounds of the Earth)
http://www.instytutsztuki.us.edu.pl/kr/akademia-dzwiekow-ziemi

Sonic Visualiser
http://www.sonicvisualiser.org/

Spear
http://www.klingbeil.com/spear/

OpenMusic
http://repmus.ircam.fr/openmusic/home

Supercollider
http://supercollider.sourceforge.net/

Fons Adriaensen software
http://kokkinizita.linuxaudio.org/

Reaper
http://reaper.fm/

Ardour
http://ardour.org/