This document was set in LaTeX. Apart from the pdf version, the LaTeX code is available at:
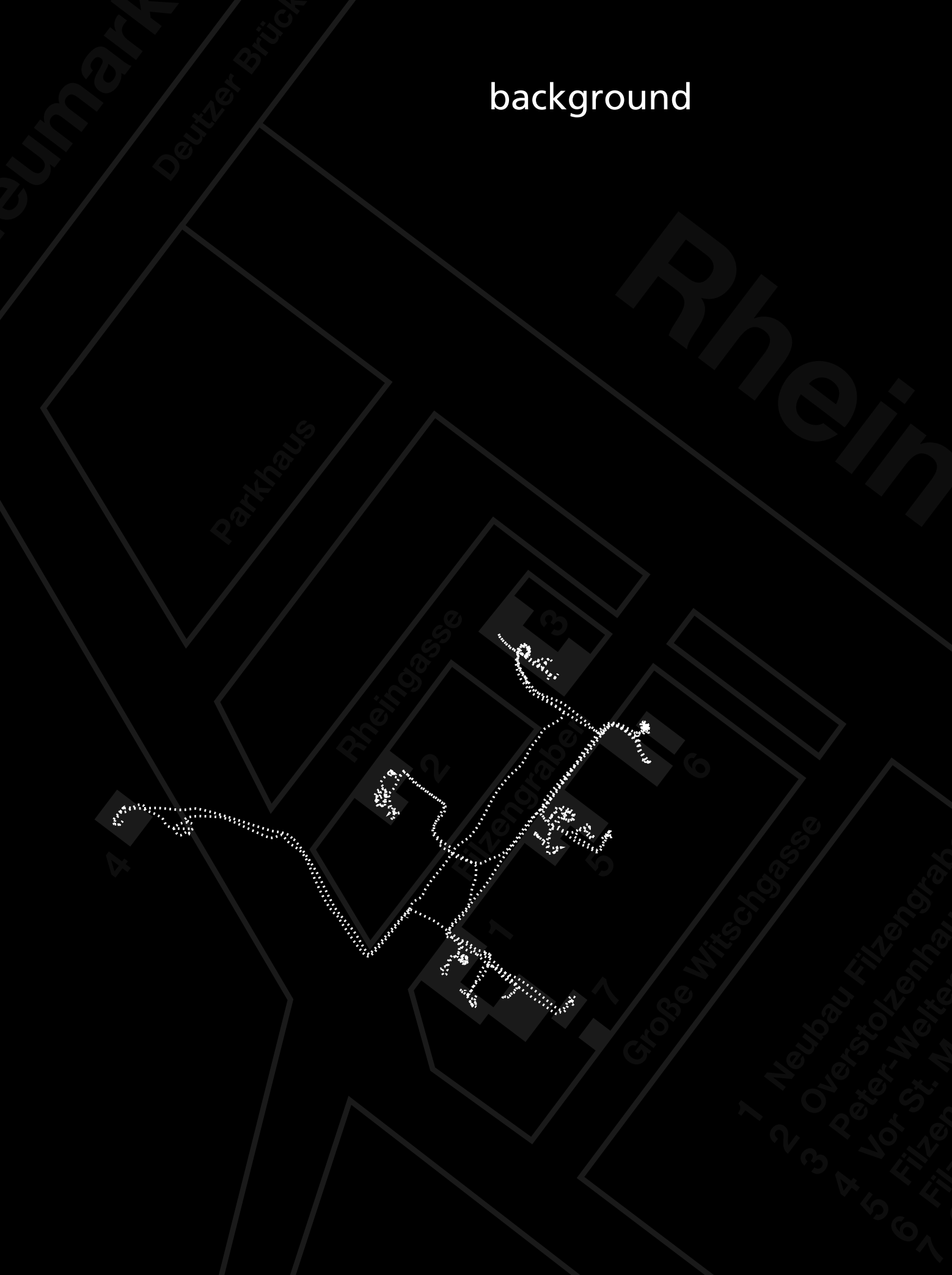
<http://osk.openkhm.de/>

background

"At the Academy of Media Arts, art, technology, and science work together for mutual enhancement. Different ways of thinking meet: theory encounters practical design, technological programmes and artistic imagination combine."[1]

The interactive sound installation *Offener Schaltkreis* is actually a result of such a meeting of two different programmes within the KHM: *Hybrid Space* and *OSFA*.

The *Hybrid Space* was founded by Prof. Frans Vogelaar within the media design department. "A new interdisciplinary field of design, researching the transformations of architectural, urban/regional space of the emerging 'information age', explores the dynamic interaction of architecture/urbanism and the space of mass media and communication networks. It develops scenarios for the interplay of public urban and public media space."[2]

The *OSFA* series of workshops introduced by Martin Rumori is connected to Klanglabor within the department of arts and media studies. *OSFA* translates to "open source for arts" and emphasizes on all aspects for using open source technology for artistic purposes.

Offener Schaltkreis is experienced by putting freely placeable speaker-cylinders on a labyrinth created out of open copper tracks. Since these tracks carry electrical audio signals, underlying sound layers become audible. This simple principle is derived from another project, created at about the same time at KHM: *Talking Cities Radio*[3]. While *Talking Cities Radio* is an interface for the audible content of an exhibition, *Offener Schaltkreis* aims to be a sound installation whose aesthetical criteria were entirely developed collaboratively from scratch.
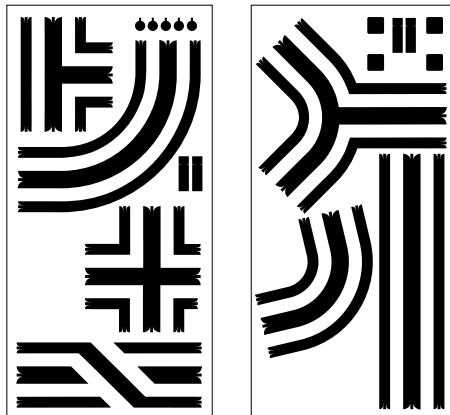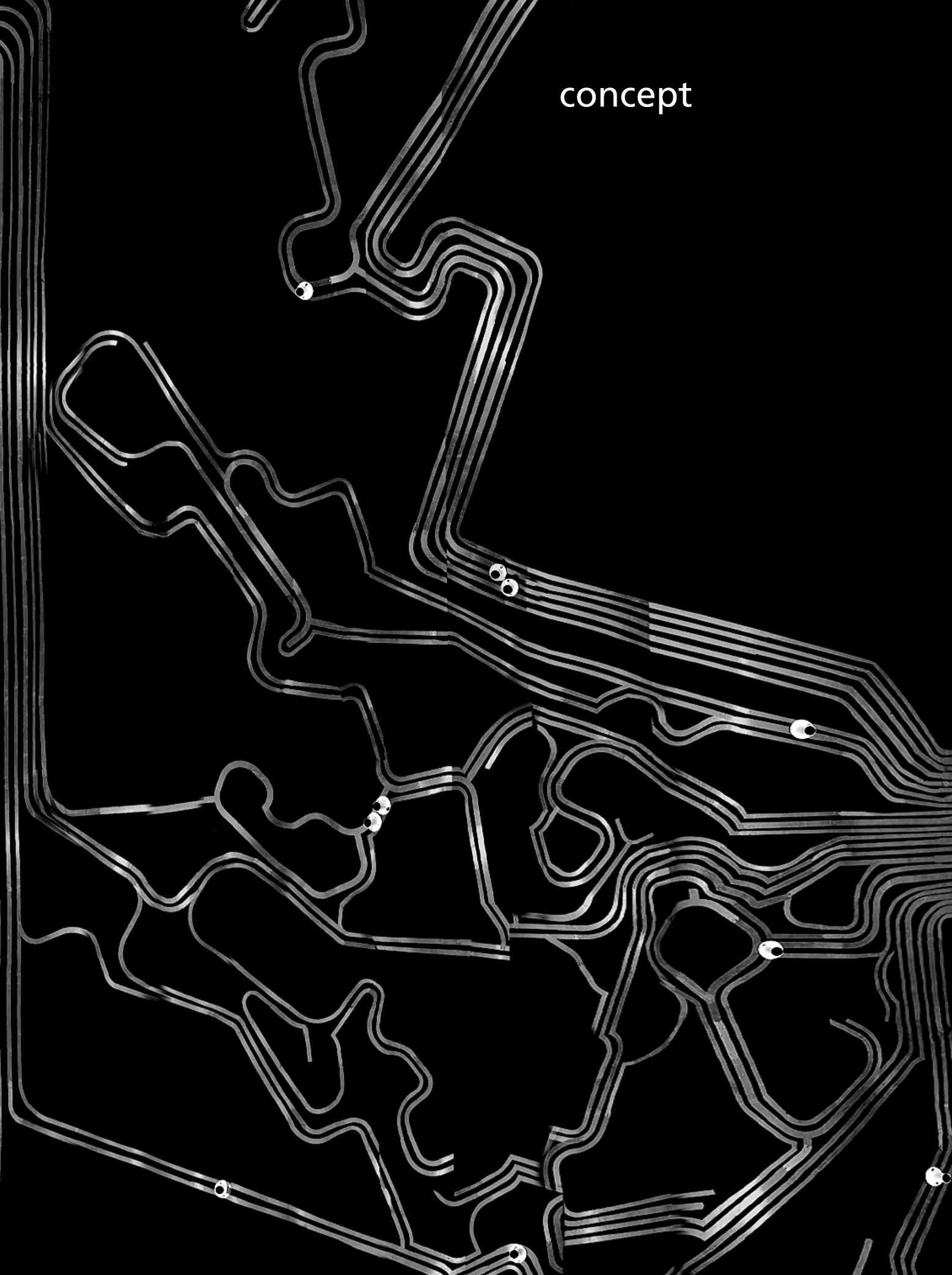
[1]from the information flyer of the Academy of Media Arts, Cologne
[2]http://hybridspace.openkhm.de
[3]http://hybridspace.openkhm.de/2006/

concept

In a city the acoustic impressions differ from place to place, just like inhabitants and surroundings are different. Every neighbourhood has its characteristics and on the way through a city not only the visual, but also the acoustic environment is constantly changing.

Within this installation we wanted to underline the simultaneity of diverse environments. The juxtaposition of heterogeneous spheres through the simple arrangement of audio sources, as the translation of what inhabitants of a city face on a daily basis. A heterotopia, not in a strict foucaultian sense, but as the coexistence and interference of places, in this case represented through audio sources. The experience of an urban environment is downscaled and transferred into a room. An experience that depends on the activity of the perceiver and his will to explore his environment.

> "They wander through the sectors of New Babylon seeking new experiences, as yet unknown ambiances. Without the passivity of tourists, but fully aware of the power they have to act upon the world, to transform it, recreate it."[4]

Through putting the speaker-cylinder on the tracks a specific place of sound is created, which uses the copper as a source for its emission and therefore for its sensual manifestation. But this mentioned place is not connected to a special place on the map. It is not static but in a permanent change. Free positioning of the speaker-cylinder allows the visitor to create his own soundscapes. Soundscapes, which open themselves only through time and movement in space.

The system of copper tracks on the ground is derived from the transportation networks of a city. This fact made it obvious from the beginning, to work with sounds and noises of the city, including their transformations and synthetic imitations. For every copper track an individual piece of sound has been created from collected sound material.

The installation is constantly playing. For every track a virtual read head loops in various speeds through a given sound piece. Every track includes four parts, which create, while playing all tracks together, changing auditory scenes.

Offener Schaltkreis reacts depending on the manner in which the speaker-cylinders are used: if nothing is moved, the sounds stay calm and soft, but if cylinders are repositioned, the currently played sound material is modulated by increasing speed, pitch and velocity.

If nothing happens during a few minutes, the installation starts cooling down, back to the quietest, lowest level, where it remains sleeping: just like every acoustic space sleeps while nobody is there. As soon as a single cylinder is moved during this state, the sound-output of all speakers suddenly jump to a higher level of activity. Thus, they give the impression of a social structure: a sensitive, pulsating, constantly shifting body, built with sound.

---

[4]Nieuwenhuis, Constant: New Babylon - a nomadic town

```
inlet  comment
bang        <-- play the sample
$0          delay 5
            $0
r cutoff 0 5    comment  Wait for the
$1-cutoff 1              cutoff to finish

$1-phase 1, 4.41e+08 300000
$1-cutoff 1
```

set the upper line- to start
at the first sample and go
forever (until the next trigger)

$0-notify

```
r $0-phase
vline~
tabread4~ $0-notify
r $0-cutoff
*~   vline~
hip~ 5
```

```
loadbang
$0               v-- re-read the original sample
read -resize /usr/local/lib/pd/doc/sound/bell.aiff $1-notify
soundfiler
```

used for load, otherwise load and then param jump!

```
loadbang
$0                    r $0-load   r $0-paramReset
                      t b
init general          $0

pd dsp 1;
BPMInit 120;
$1-wave xticks 0 5 5;
$1-ccInit 26;          $1-shiftInit 1;
$1-chInit 1;           $1-scaleInit 1;
$1-loadInit 7;         $1-axisInit 0;
$1-rateInit 50;
$1-ccName unknown;
```
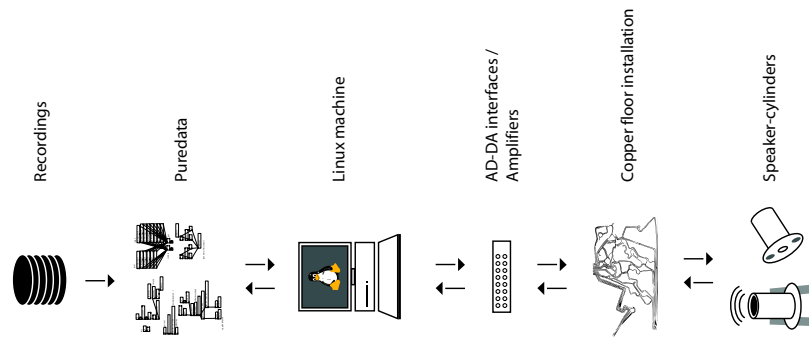
```
inlet                    r $0-power   r $0-setPower
phasor~                  switch~
threshold~ 0.001 0 0.001 0
t
s $0-loopRestarted
r $0-loop-length
+~ 1
r $0-loop-begin        on/off    rate  freq     reset
+~ 0                   inlet     inlet inlet     inlet
                                                 0
r $0-power             t f f b
metro 40               switch~
snapshot~
s $0-active-position
r $0-arraysize         phasor~  metro  arraysize $1
+~ 0                   snapshot~
+~ 1                             400
tabread4~ $0-sample              t
outlet~
```

```
                       t f f
                       tabread $1
                       outlet outlet    0.847
                       value  position
```

```
inlet
dur rate preset
unpack f f f
s $0-setDuration
     s $0-rateInit
          s $0-loadInit
```

```
inlet
```

```
duration
4.001
expr 1 / ($f1 * 60)

on/off  rate    freq      global_rewind       r $0-scratch
(x)     30      0.004
WaveEngine $0-wave                   bpm
expr ($f1 + 1) / 2       time        0
t f f                    370.5       expr $f1 / 240
     value                           s $0-freq
     0.900
outlet
```

```
inlet~ inlet
               loadbang
metro 20
               table $0-fft-spec 64
t b b
pd fft
29       29 seems to be the bin of 20khz
tabread $0-fft-spec          r calibrate
0.054                    t
t f b                    t
                         0
- $1
0.054
mosesKaskade 0.1 0.4 0.9 1.2 1.5
outlet
```

```
r~ $1-ch       r main   r $2    rohrWatcher $1   r doNotify
r $0-notify                     rem    add
+~
+~                                              r doRecout
                                       r $1-dac
lop~ 14000                             r $1-no
lop~ 14000                             moses
lop~ 14000                             0
lop~ 14000                                    spigot
hip~ 300                 spigot
r~ ref                   pd oneshot
dac~ $1  s~ $1-dac       s~ $0-notify   throw~ recout
```

Recordings — Puredata — Linux machine — AD-DA interfaces / Amplifiers — Copper floor installation — Speaker-cylinders

A Linux PC with a multichannel audio interface drives the openly installed copper tracks (mass and signals). The freely movable speaker-cylinders also have open copper contacts at the bottom so that placing them on the tracks connects the amplified audio signals to the speakers.

The audio recordings are played back by a *pd* patch[5]. The patch is freely available at http://osk.openkhm.de. It reads the materials in progressing loops, playing repeatedly with forward-moving loop markers. That kind of "macro-granular synthesis/sequencing" creates a diffuse sound that morphs between different areas of the recordings, presenting ever-changing sound facets.

The interactive mapping of the visitor's activity to sound shaping parameters like volume, "loop" length (or "macro grain length") and thus pitch and speed is done directly in each track's player instance.

The more the system is stimulated (up to a certain point), the less the actions of the visitors are taken into account. This kind of damping makes it hard to reach the defined maximum value, allowing for soft boundaries of the dynamic range. The lower end of the dynamic range represents the above-mentioned "sleeping". In this state, the least activity on an arbitrary speaker leads to a sudden high increase.

In order to accomplish the interactive mapping, it is necessary to track the visitors' actions. Therefore discrete "put" and "remove" events are generated based on electrical measurements on the copper tracks.

Besides the actual audio content signals, all tracks carry an inaudible 20 kHz sine signal at constant amplitude. This is used as a reference signal for counting the amount of speakers that are placed properly on the copper tracks. The sum of the audio and the reference signals is fed back into the corresponding **adc**~ inputs of *pd* where the 20 kHz sine signal is isolated.


reference signal   content signal   sum signal
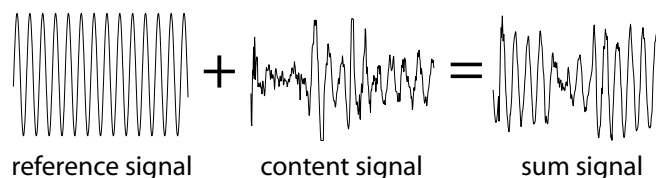
[5]Miller Puckette. About Pure Data. The Pure Data Portal.*http://puredata.org*, 2006.

When no speaker is placed on a specific track, the feedback signal of that track will be at $-\frac{Y}{}$ db in amplitude, since the electrical circuit is simply not closed. In the arrangement, we avoided adjacent tracks of the same kind, thus making sure that masses and signals are always alternating. As a result, a proper speaker connection is guaranteed at any arbitrary position of the installation.

With the first speaker placed, the amplitude of the isolated feedback signal jumps to a certain value well above zero. Due to electrical laws, this level U_{sens} converges logarithmically towards the amplitude of the fed-in signal when more speakers are added to the same track, because all speakers will be situated in a parallel connection ($U_{sens} = 1 - \frac{1}{1+n}$).[6] This exponential graph can be transformed in order to get the discrete integer value of placed speakers.

The tracking of the visitors' activity is accomplished by interpreting this number on a per track basis. The change of this quantity is either an addition or removal of speakers. As described above, this information is then used as a parameter for the sound generation within *pd*.

---
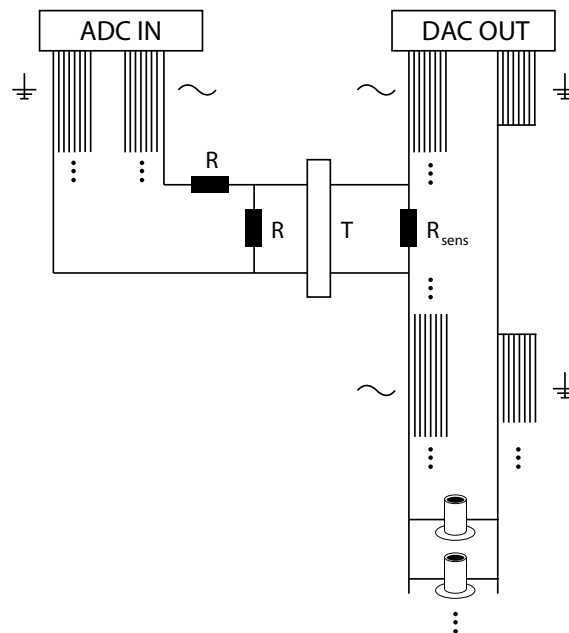
[6]The more speakers are placed in that parallel connection, the more the equivalent resistance of the floor installation is decreased resulting in an increase of U_{sens} on that voltage divider.
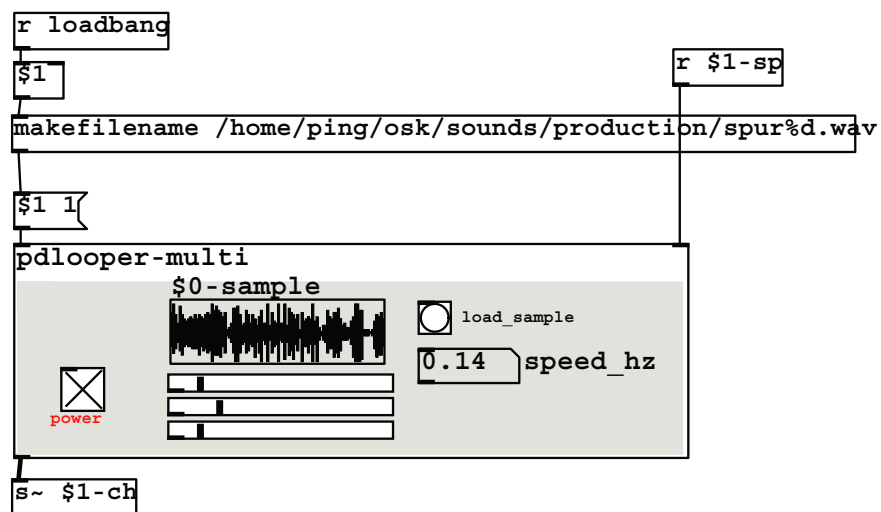
rack1

playerWrapper 1
playerWrapper 2
playerWrapper 3
playerWrapper 4
playerWrapper 5
playerWrapper 6

rack2

playerWrapper 9
playerWrapper 10
playerWrapper 11
playerWrapper 12
playerWrapper 13
playerWrapper 14
playerWrapper 15
playerWrapper 16

Patch 1:
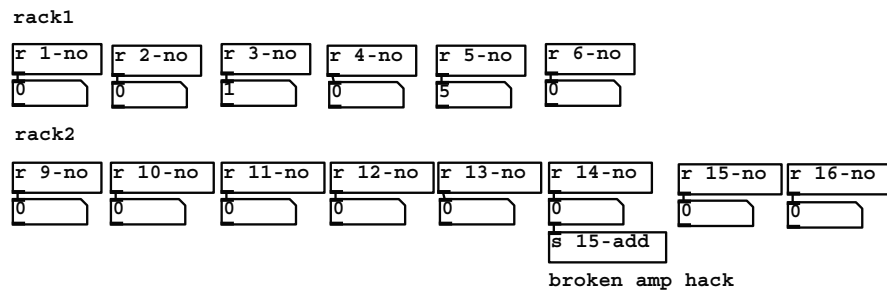For each copper track on the floor a unique instance of a player abstraction
is running.

```
r loadbang                                              r $1-sp

$1

makefilename /home/ping/osk/sounds/production/spur%d.wav

$1 1

pdlooper-multi
        $0-sample
                                      ◯  load_sample

                                      0.14   speed_hz

   ⊠
  power


s~ $1-ch
```

Patch 2:
The player abstraction is moving through the loaded wave in slowly pro-
gressing loops, creating a macro-granular synthesis/sequencing sound that
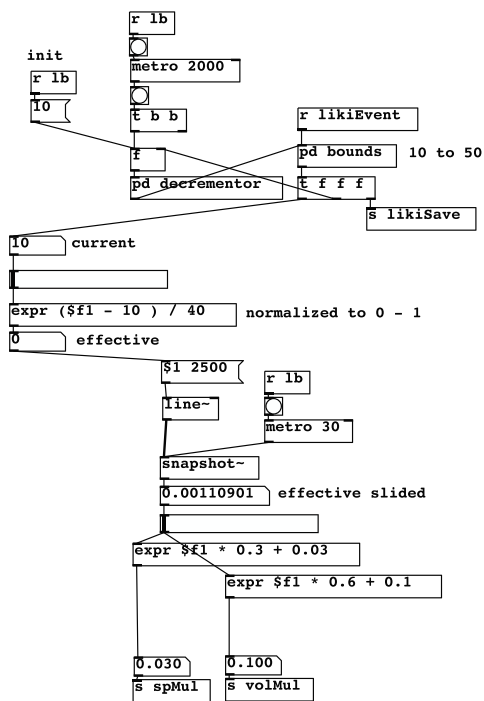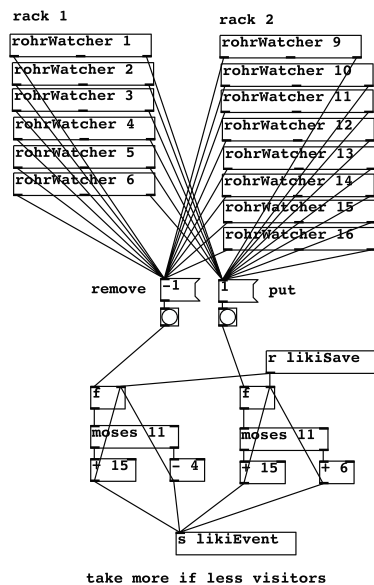varies in pitch and speed.

```
rack1                 rack2
┌─────────────────┐  ┌─────────────────┐
│ rohrWrapper 1   │  │ rohrWrapper 9   │
├─────────────────┤  ├─────────────────┤
│ rohrWrapper 2   │  │ rohrWrapper 10  │
├─────────────────┤  ├─────────────────┤
│ rohrWrapper 3   │  │ rohrWrapper 11  │
├─────────────────┤  ├─────────────────┤
│ rohrWrapper 4   │  │ rohrWrapper 12  │
├─────────────────┤  ├─────────────────┤
│ rohrWrapper 5   │  │ rohrWrapper 13  │      ┌───────┐ ┌─┐
├─────────────────┤  ├─────────────────┤      │ r lb  │ │ │
│ rohrWrapper 6   │  │ rohrWrapper 14  │      ├───────┤ └─┘
└─────────────────┘  ├─────────────────┤      │ s locb│
                     │ rohrWrapper 15  │      └───────┘
                     ├─────────────────┤
                     │ rohrWrapper 16  │
                     └─────────────────┘

where are the rohrs set:

rack1
┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐
│ r 1-no │ │ r 2-no │ │ r 3-no │ │ r 4-no │ │ r 5-no │ │ r 6-no │
├────────┤ ├────────┤ ├────────┤ ├────────┤ ├────────┤ ├────────┤
│ 0      │ │ 0      │ │ 1      │ │ 0      │ │ 5      │ │ 0      │
└────────┘ └────────┘ └────────┘ └────────┘ └────────┘ └────────┘

rack2
┌────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐ ┌─────────┐
│ r 9-no │ │ r 10-no │ │ r 11-no │ │ r 12-no │ │ r 13-no │ │ r 14-no │ │ r 15-no │ │ r 16-no │
├────────┤ ├─────────┤ ├─────────┤ ├─────────┤ ├─────────┤ ├─────────┤ ├─────────┤ ├─────────┤
│ 0      │ │ 0       │ │ 0       │ │ 0       │ │ 0       │ │ 0       │ │ 0       │ │ 0       │
└────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘ └─────────┘
                                                          ┌─────────┐
                                                          │ s 15-add│
                                                          └─────────┘
                                                          broken amp hack
```
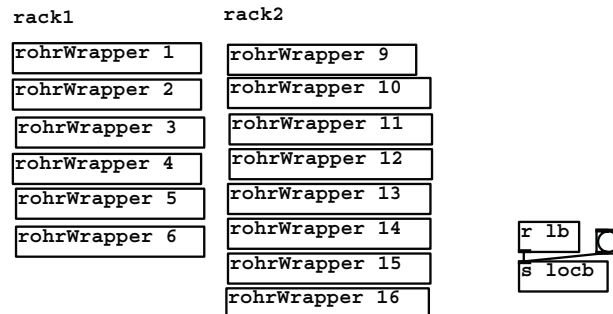
Patch 3:
For each track a monitor abstraction is loaded as well, in order to count the
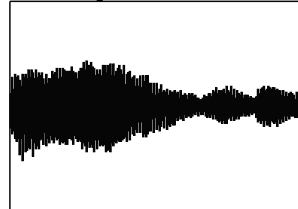number of placed speaker-cylinders on a per-track basis.

Patch 4:
Each placement or removal of speaker-cylinders is recognized by the patch and fed into a "leaky integrator", whose amount is increased by these events and decreased by time. This amount controls the changes in pitch and speed for the player-abstractions.

r lb

init
r lb
10

metro 2000

t b b   r likiEvent

f   pd bounds   10 to 50

pd decrementor   t f f f

s likiSave

10   current

expr ($f1 - 10) / 40   normalized to 0 - 1

0   effective

$1 2500   r lb

line~   metro 30

snapshot~

0.00110901   effective slided

expr $f1 * 0.3 + 0.03

expr $f1 * 0.6 + 0.1

0.030   0.100

s spMul   s volMul

eg. globalSpeed

likiSave is used to call the current value without
triggering the increment

rack 1   rack 2
rohrWatcher 1   rohrWatcher 9
rohrWatcher 2   rohrWatcher 10
rohrWatcher 3   rohrWatcher 11
rohrWatcher 4   rohrWatcher 12
rohrWatcher 5   rohrWatcher 13
rohrWatcher 6   rohrWatcher 14
                    rohrWatcher 15
                    rohrWatcher 16

remove -1   1   put

r likiSave

f   f

moses 11   moses 11

+ 15   - 4   + 15   + 6

s likiEvent

take more if less visitors

Patch 4:
Each placement or removal of speaker-cylinders is recognized by the patch and fed into a "leaky integrator", whose amount is increased by these events and decreased by time. This amount controls the changes in pitch and speed for the player-abstractions.

```
inlet comment

bang      <-- play the sample
                          Wait for the
$0            delay 5     cutoff to finish
;             $0
; comment     ;
$1-cutoff 0 5 $1-phase 1, 4.41e+08 300000;
              $1-cutoff 1


r $0-phase

vline~

tabread4~ $0-notify        loadbang    □  <-- re-read the original sample
          r $0-cutoff
                           $0
*~        vline~
                           read -resize /usr/local/lib/pd/doc/sound/bell.aiff $1-notify
hip~ 5
outlet~                    soundfiler
```
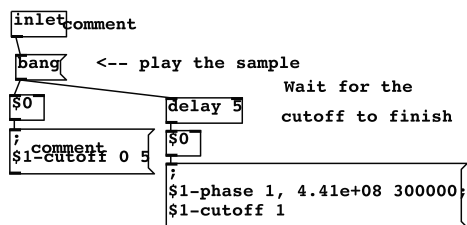
$0-notify

set the upper line~ to start
at the first sample and go
forever (until the next trigger)
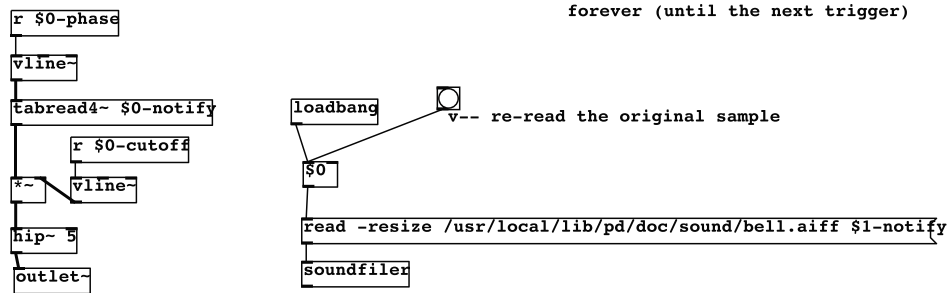
Patch 5:
To give the visitors clear feedback about their actions, a short notifying
sound is played for each proper placement of a speaker-cylinder.
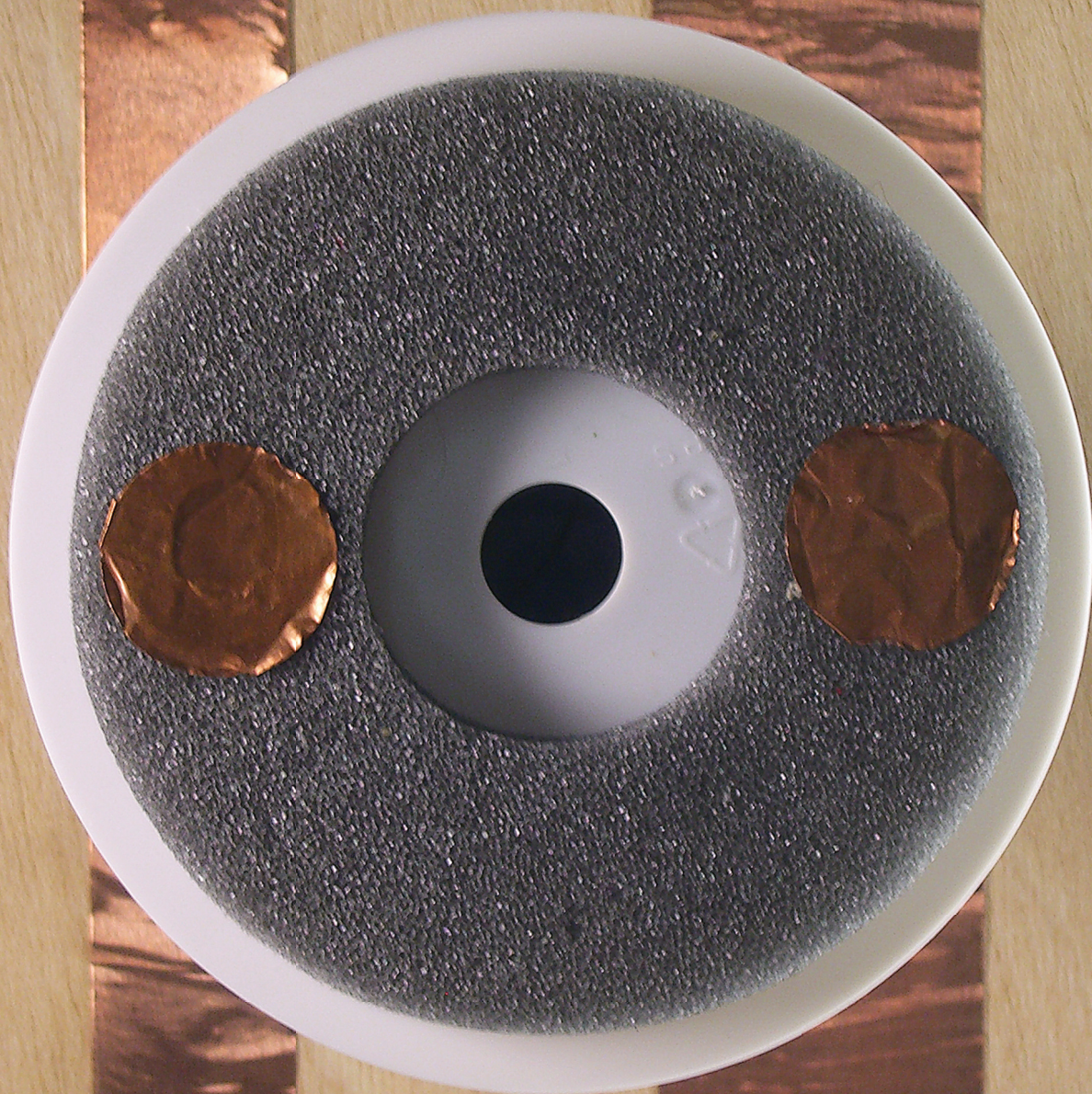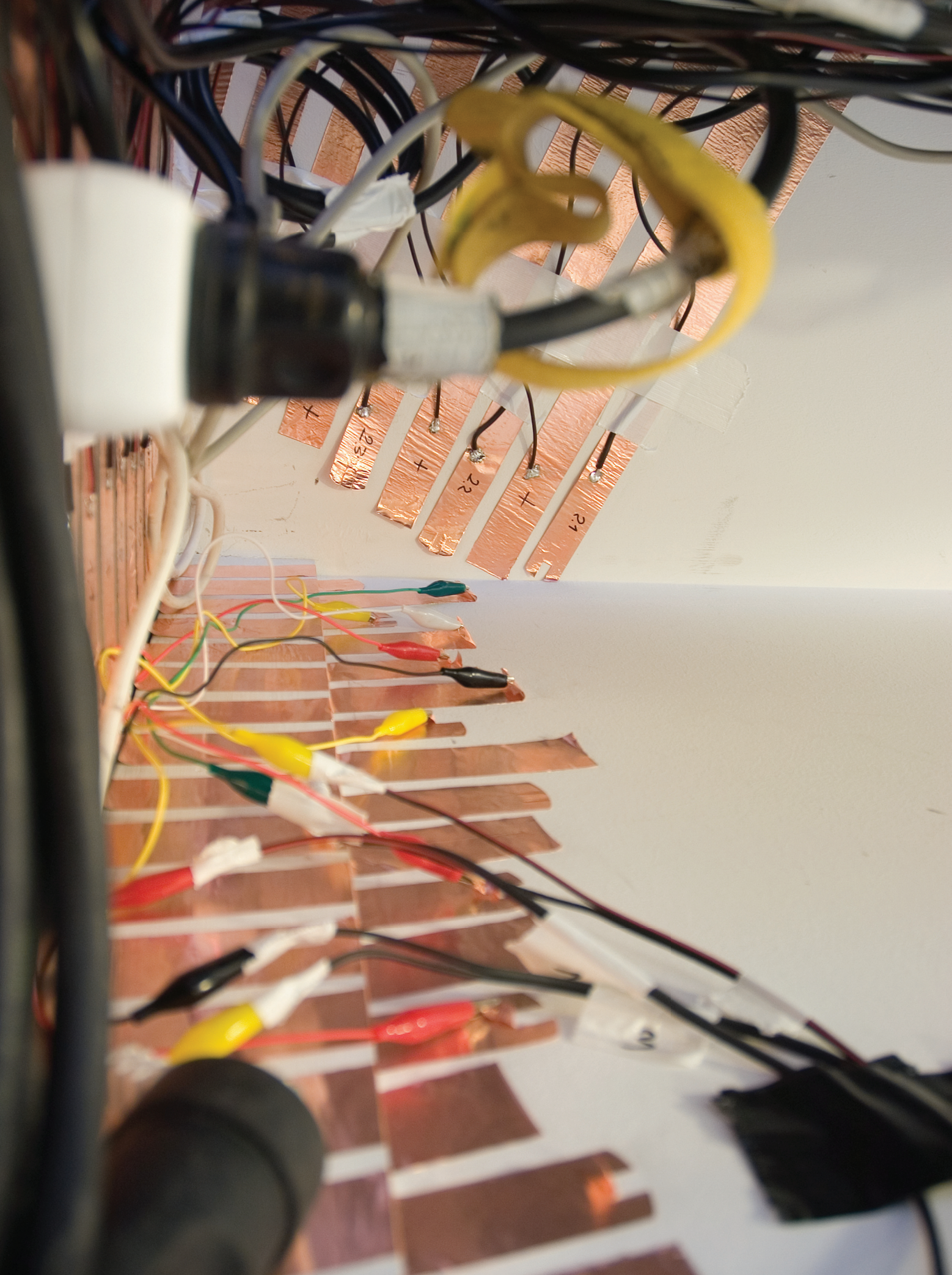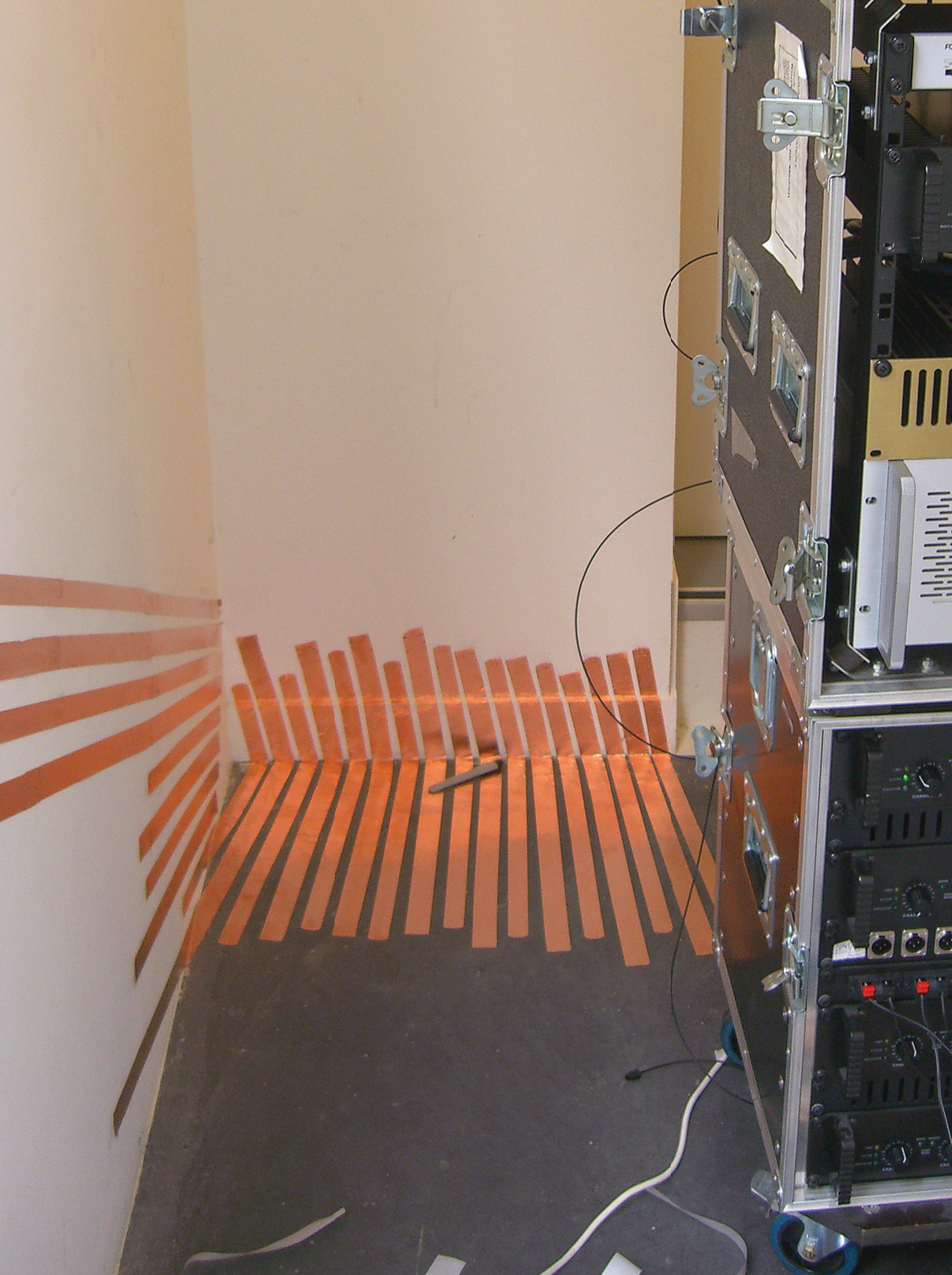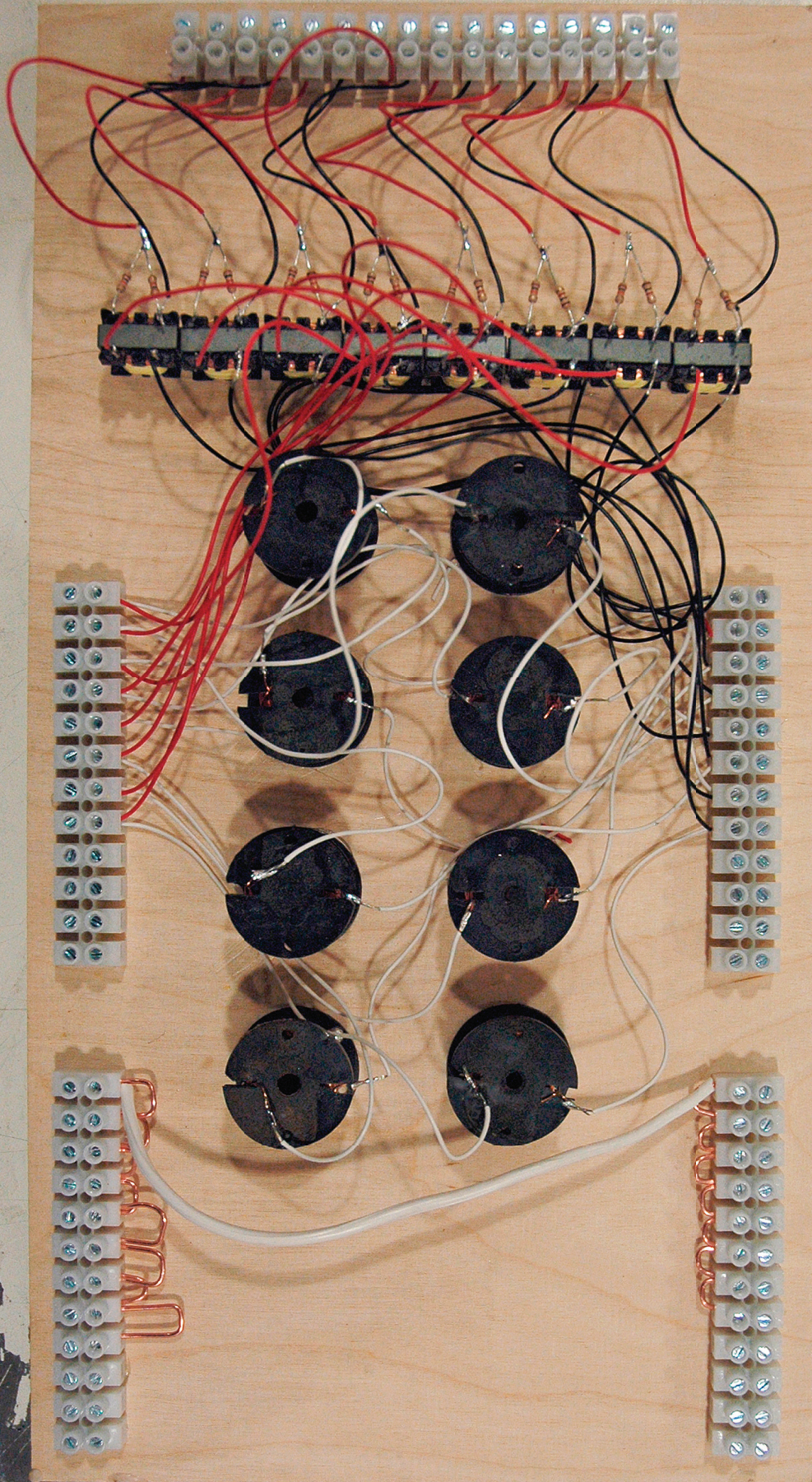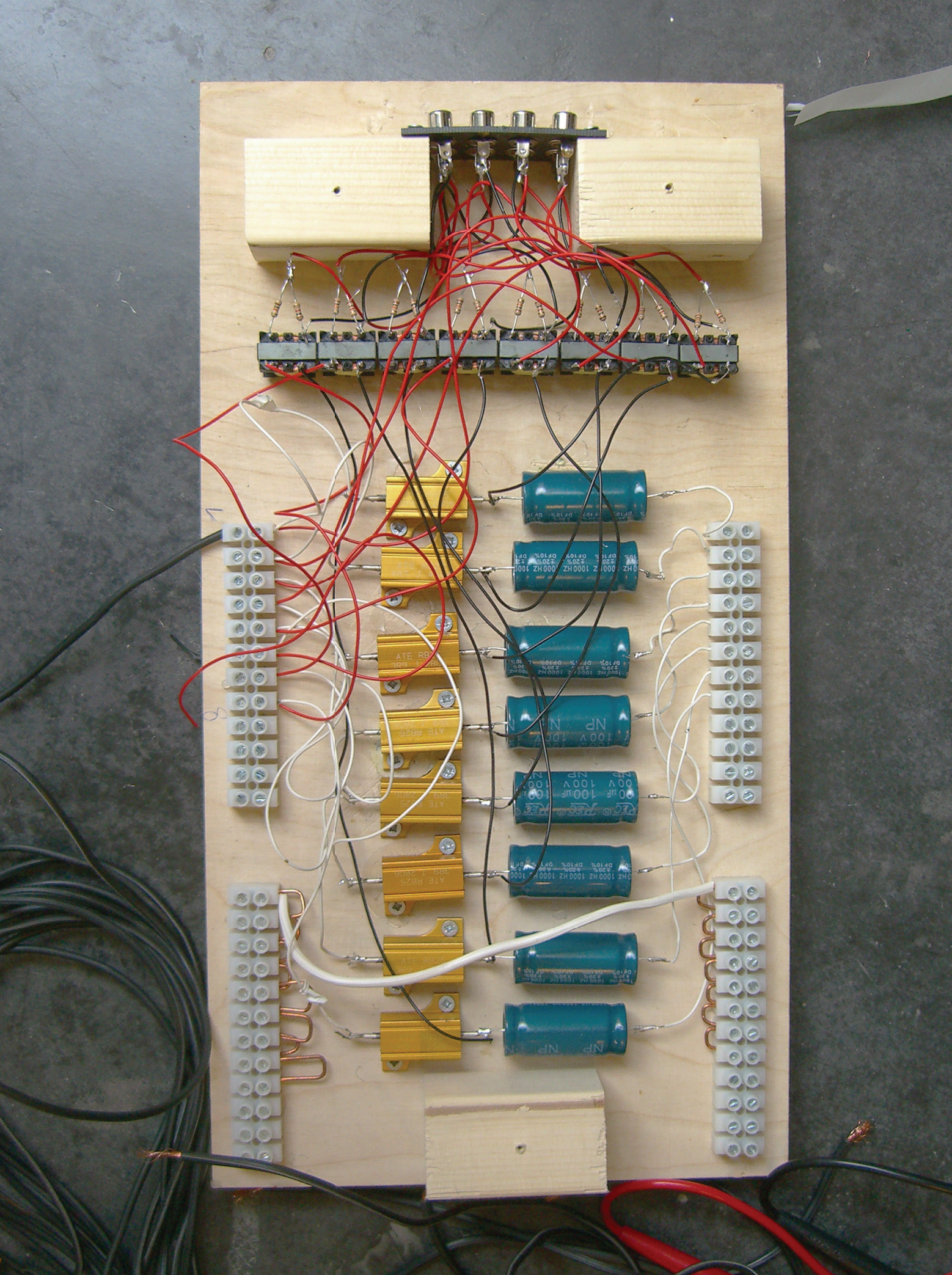
lange nacht der museen
köln 2006

makeart
poitiers 2007

Maison d'Architecture, Poitiers
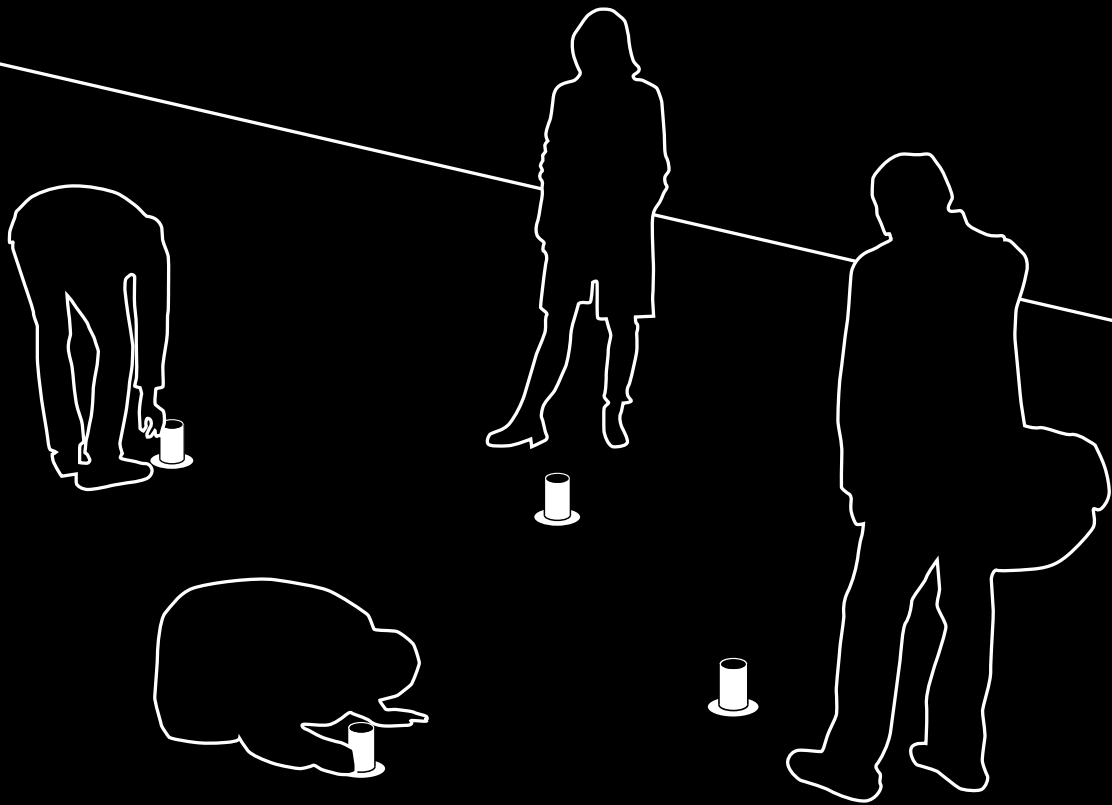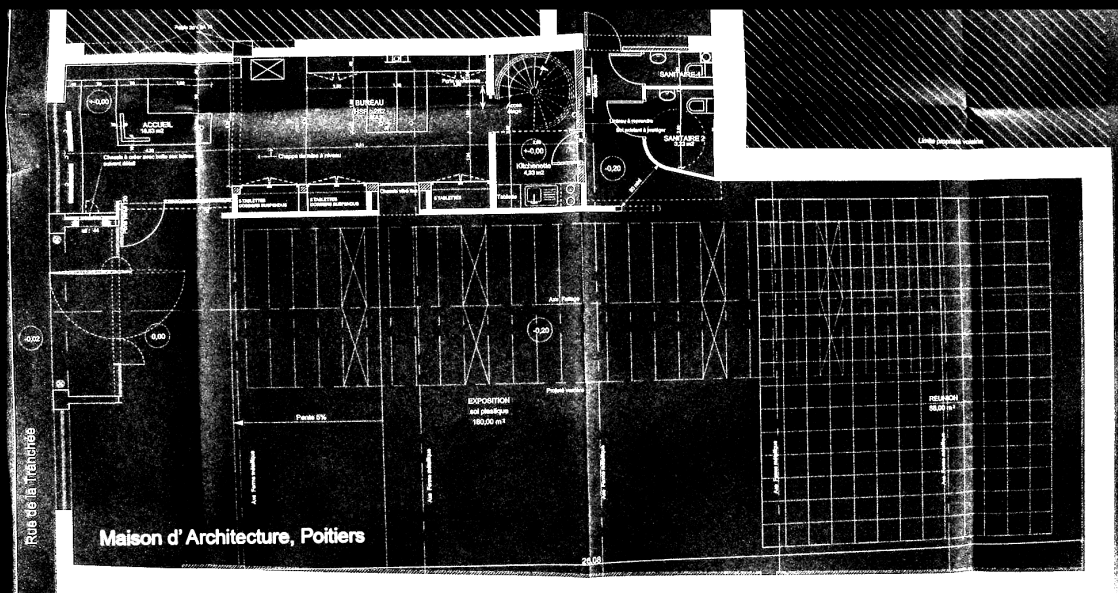
qt_proofsheet makeart2007_timelapse.mp4 makeart2007_timelapse.tga
–spacing=0 –title=0 –timecode=0 –framesize=266,200
–framesperrow=14 –framerate=0.4 –duration=5,595

This is a sequence of 125 images that are taken from a timelapse video (http://osk.openkhm.de/repository/video/osk_makeart.mp4) that spans from April 2nd to April 9th at makeart 2007 in the Maison d'Architecture Poitiers. The construction and disassembly time as well as the whole festival period is shown. Please note that the disassembly period is running slower and night times have been removed.

Since this work originated out of the seminar series *OSFA*, the use of open sourced software was indeed one of the few fixed preconditions for developing this project.

The installation tries to empower the visitors or listeners to act on their own. We try to give them the freedom to use the installation in any way they wish. This attempt finds its counterpart in the use of free software, within the empowerment of using and modifying software in any way we choose.

Of course, also the economic aspect of using open source software is important to its use in the context of media art, since it sometimes simply means: "free as in free beer".

Open Source is generally available on more platforms than proprietary software, since everybody can hack a port to his favorite system, thus complying more easily to his predefined requirements.

Works that are developed in an academic context, like *Offener Schaltkreis*, are often intended to be presented as a publication that documents more than just the result – but also the path that was taken during the design process. Obviously, presenting code as open source is an almost obligatory requirement for this way of highlighting processes besides the result itself. Furthermore, the open source community provides proven systems for licensing and sharing the author's work.

Our thanks go to Martin Nawrath, technical staff of the KHM, Prof. Anthony Moore, Head of Klanglabor at KHM, Tobias Beck, Michael Thies, Anselm Bauer and the entire *Talking Cities Radio* team.

Offener Schaltkreis

Project Team: Christoph Haag, Martin Rumori, Franziska Windisch and Ludwig Zeller.

Academic Support: Prof. Anthony Moore

Project Support: Tobias Beck, Micha Thies, Anselm Bauer, Frank Barknecht

Technical Support: Martin Nawrath

Special Thanks to the entire Talking Cities Radio team, goto10 and the many people at MakeArt festival, who helped us scrub the floor at Maison d'Architecture...

Offener Schaltkreis continues the original concept of Talking Cities Radio.

Talking Cities Radio

Project Leader: Prof. Frans Vogelaar

Project Management: Christoph Haag und Ina Krebs

Project Support: Andreas Muxel (light concept and design), Isabelle Niehsen (graphic design), Heiner Schilling (photography), Therese Schuleit

Technical Support: Martin Nawrath, Heinz Nink, Martin Rumori

Talking Cities Radio was realised in cooperation with **urban drift productions Ltd.** at the Department of Hybrid Space,
Academy of Media Arts, Cologne.

Kunsthochschule für Medien Köln
Academy of Media Arts
École Supérieure des Arts et Médias

K L A N G

L A B O R

KHM / Department of Hybrid Space

lablll
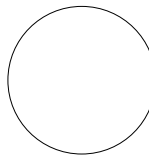
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