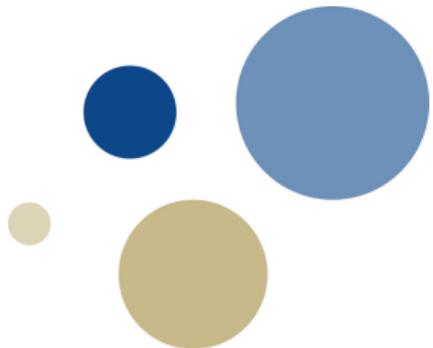




Norwegian University of  
Science and Technology



## **Physical Computing Workshop: Day 1**

Intuitive Handmade Electronic Music

Anna Xambó

Department of Music, NTNU

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# Setting up



- Fill in the pre-questionnaire (Canvas)
- Download material from day 1 (Github)
- Download and install Puredata Vanilla:  
<https://puredata.info/downloads/vanilla>
- Create a user account at Freesound.org

# Learning Outcomes



By the end of the session, you will be able to...

- Create basic sonic handmade circuits with everyday objects.
- Explore the practice of circuit sniffing using radios, microphones and speakers.
- Reflect on this type of recordings by describing their sound properties.
- Discern the fundamental properties of an interactive musical system.
- Demonstrate a custom-made sampler instrument in a performance setting.
- Reflect on the custom-made sampler instrument and performance using a blogging style.

## Preparation: What to Bring to Class?

For the first day, you are welcome to bring (it is likely you can find some of the items in your respective *electronikklabs*, and you can work in teams to complement each other's collections of items):

- a raw loudspeaker of any size (if you have it) – see photo above
- a 9-volt battery
- jumper leads with alligator clips (only two will be provided, you will need at least one more)
- any type of contact mic, pickup or piezo (if you have it, we will work with them in groups)
- a medium size nail
- pop-tabs from soda cans, paper clips, nuts and bolts
- a can with a smaller diameter than your speaker (if you have it)
- some lentils, beans, or gravel (if you have it)
- a small piece of aluminium foil (if you have it)
- plastic or metal bowls, larger than your speaker, or a toilet plunger (if you have it)
- cheap headphones / earplugs
- a mobile phone with a radio program or a battery-powered AM radio
- a battery-powered amplifier (optional, you will have 1 per group)
- a minijack to jack adapter (if you have it, for the battery-powered amplifier)
  
- an audio recording device per group (a mobile phone is accepted)



# Block I

## The Victorian Synthesizer

### Circuit Sniffing

### Soundwalking Activities

## The seven basic rules of hacking (Collins 2006)



- Rule #1: Fear not!
- Rule #2: Don't take apart anything that plugs directly into the wall.
- Rule #3: It is easier to take something apart than put it back together.
- Rule #4: Make notes of what you are doing as you go along, not after.
- Rule #5: Avoid connecting the battery backwards.
- Rule #6: Many hacks are like butterflies: beautiful but short-lived.
- Rule #7: In general, try to avoid short circuits.

## Exercise 1: Loudspeakers with batteries



Passing the battery current through the speaker coil creates an electromagnet that interacts with the speaker's fixed magnet and moves the cone in or out.

Exercise based on "Chapter 5. The celebrated jumping speaker of Bowers county: Twitching loudspeakers with batteries" (Collins 2006).

## Exercise 1: Loudspeakers with batteries

Passing the battery current through the speaker coil creates an electromagnet that interacts with the speaker's fixed magnet and moves the cone in or out.

- Step 1: Clip 1 from battery terminal ("+" or "-") to loudspeaker terminal. Clip 2 from speaker terminal to battery terminal intermittently.
- Step 2: Clip 1 from battery terminal ("+" or "-") to loudspeaker terminal. Clip 2 from speaker terminal to conductive metal. Clip 3 from battery terminal to nail / pointed conductive metal. Touch nail to metal. Send short pulses to keep the battery alive.
- Replace the two metal pieces with coins, paperclips, aluminum pop-tabs. Place it inside the speaker cone. Try to change the pitch and rhythm of the buzzing sounds.
- Try to connect them in series and in parallel.
- Try to use your hands, bowls, and so on, to mute and resonate the sound further.
- Put gravel, coins, or dried lentils inside the cone for additional rhythmic accents.
- Check the Victorian Synthesizer by John Bowels: <http://www.jmbowers.net/works/victorian.html>

Exercise based on "Chapter 5. The celebrated jumping speaker of Bowers county: Twitching loudspeakers with batteries" (Collins 2006).

## Exercise 2: Circuit sniffing



Radios, inductive telephone pickup coils or loose electric guitar pickups capture electromagnetic vibrations and translate them into signals that can be heard through a loudspeaker. We need to find sweet spots of electromagnetic fields.

- If you have an old radio, turn it on. Tune it to a dead spot. Try moving it around various electrical appliances: fluorescent lights, electric motors, computers, cell phones, infrared remote controls.
- Alternatively, a telephone pickup (coil of wire) can act like a radio antenna if plugged into an amp. Use it like a stethoscope exploring various electrical appliances: laptops, fans, toys, and so on.

Exercise based on "Chapter 3. Circuit sniffing: using radios and coils to eavesdrop on hidden electromagnetic music" (Collins 2006).

## Exercise 2: Circuit sniffing

The screenshot shows a sound file titled "Soundwalk with an induction microphone" by user "laspaziale". The page includes a waveform visualization, download statistics (36 times), and a Creative Commons license notice. Technical details like duration (02:59.814), file size (32.9 MB), and sample rate (48000.0 Hz) are listed. A "Comments" section is present, and social sharing links for Twitter, Tumblr, and Print are at the bottom.

Soundwalk with an induction microphone

laspaziale July 28th, 2011

A soundwalk with an induction microphone looking for sweet spots in an apartment.

Downloaded 36 times Login to download

soundwalk noise electromagnetism hums

Comments

This sound has not been commented on yet, be the first to comment!

Please log in to comment

creative commons This work is licensed under the Attribution License.

Type Wave (.wav)  
Duration 02:59.814  
Filesize 32.9 MB  
Samplingrate 48000.0 Hz  
Bitdepth 16 bit  
Channels Stereo

Similar sounds

Sound illegal or offensive? Flag it!

Share url: <https://freesound.org/s/478008/>

Developers Blog About Terms of use Design by [Pixelshell](#). Code by [MTG \(UPF\)](#). Some Rights Reserved.

<https://freesound.org/people/laspaziale/sounds/478008/>

## Exercise 3: Speaker as a microphone



Headphones are tiny speakers (both have coils and magnets to transform acoustic sound into an electrical signal or the other way around). The same electromagnetic force is used for both microphones and speakers.

- Try to use headphones as speakers using the circuit sniffing technique.

Exercise based on:

- "Chapter 4. In/out (the eight rule of hacking): speaker as microphone, microphone as speaker – the symmetry of it all" (Collins 2006)
- Video "Tutorial 2: In/Out - Electromagnetism Explained (Chapter 4)" (source: [www.nicolascollins.com](http://www.nicolascollins.com))  
<https://www.nicolascollins.com/video/tutorial02/tutorial02-desktop.m4v>

## Exercise 4: Contact mics and amps



A contact mic, also known as a pickup or piezo, is a form of microphone that senses audio vibrations through contact with solid objects.

- Go for a soundwalk with contact mics and amps using the circuit sniffing technique. It is recommended to making firm physical contact with the vibrating object. Try: guitars, violins, drums, pots and pans, wrists and knees, foreheads, pinball machines.

Exercise based on:

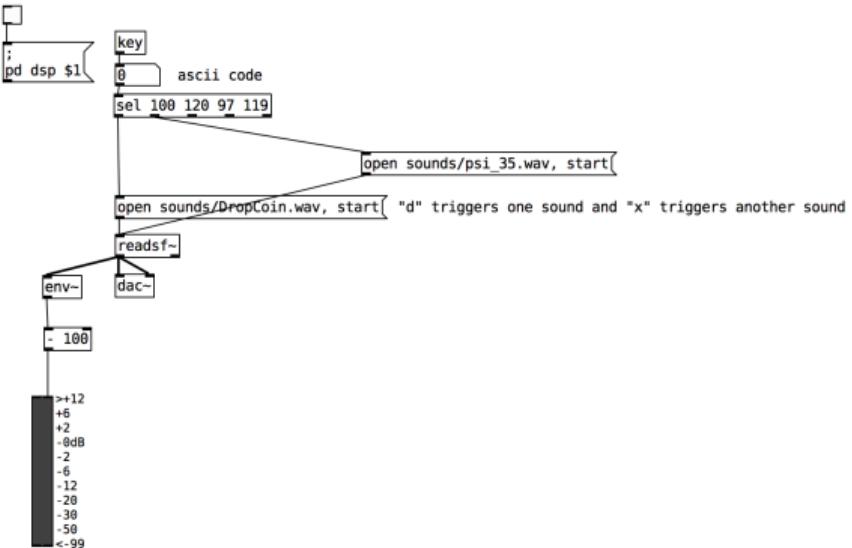
- "Chapter 7. How to make a contact mike: Using piezo disks to pick up tiny sounds" (Collins 2006)
- Video "Tutorial 5: How to Make a Contact Mike (Chapter 7)" (source: [www.nicolascollins.com](http://www.nicolascollins.com))  
<https://www.nicolascollins.com/video/tutorial05/tutorial05-desktop.m4v>



## Block II

# Basic Interactive Behavior: Building a Basic Sampler

# A Basic Sampler in Pd Vanilla



<https://github.com/axambo/physical-computing-workshop-v2>



# Block III

## Fieldwork

## Fieldwork I: Circuit sniffing + soundwalking activities



- Generation of audio recordings from soundwalks and circuit sniffing using loudspeakers with batteries, pickup coils, radios, contact mics.
- Description of the sounds: action, material, qualities of the sound.
- Selection of the most representative sounds and upload them to Freesound.org.
- If suitable, distribution of work between group members “in the wild” and group members in the “station” e.g. Oslo vs Trondheim or across campuses.
- Writing of a blog post explaining the above process.



# Block IV

## Rehearsal and Performance