PENCIL FIELDS

An Expressive Low-Tech Performance Interface for Analog Synthesis

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Me…

- Composer
- Improviser
  - free improv, solo or with others
  - piano and/or electronics
- PhD in evolutionary algorithms as tools for composition (2004)
  - Nord Modular G2 – the Patch Mutator, etc...
- Research interests
  - technologies for improvisation and realtime creativity
  - computational models of artistic creative process

The Problem…

- How to improvise on equal terms with an acoustic musician?
  - not being tied back by prepared pocesses or presets
  - to be able to switch direction in an instant
  - to be able to explore the full sound space potential of a sound engine in performance - not editing
- A freedom equal to
  - acoustic instruments in free improvisation
  - electronic touch instruments
    - Waisvisz' Crackle Box
    - Peter Blasser's instruments (e.g., the Kittenettik)

Goals

- Multi-parameter control
  - as exploration of a space of potenial sounds
- Lift my hands – it goes quiet
- Physicality
  - using my body to play
  - each sonic gesture corresponds to a physical gesture
  - effort
    - (at least) emulate the fact that the sounding energy comes from my body
- Intimacy (Wessel et al)
  - continuity
  - minute control / fingertip control
  - no latency
- Visibility
  - communicate with the audience

Results in the digital domain

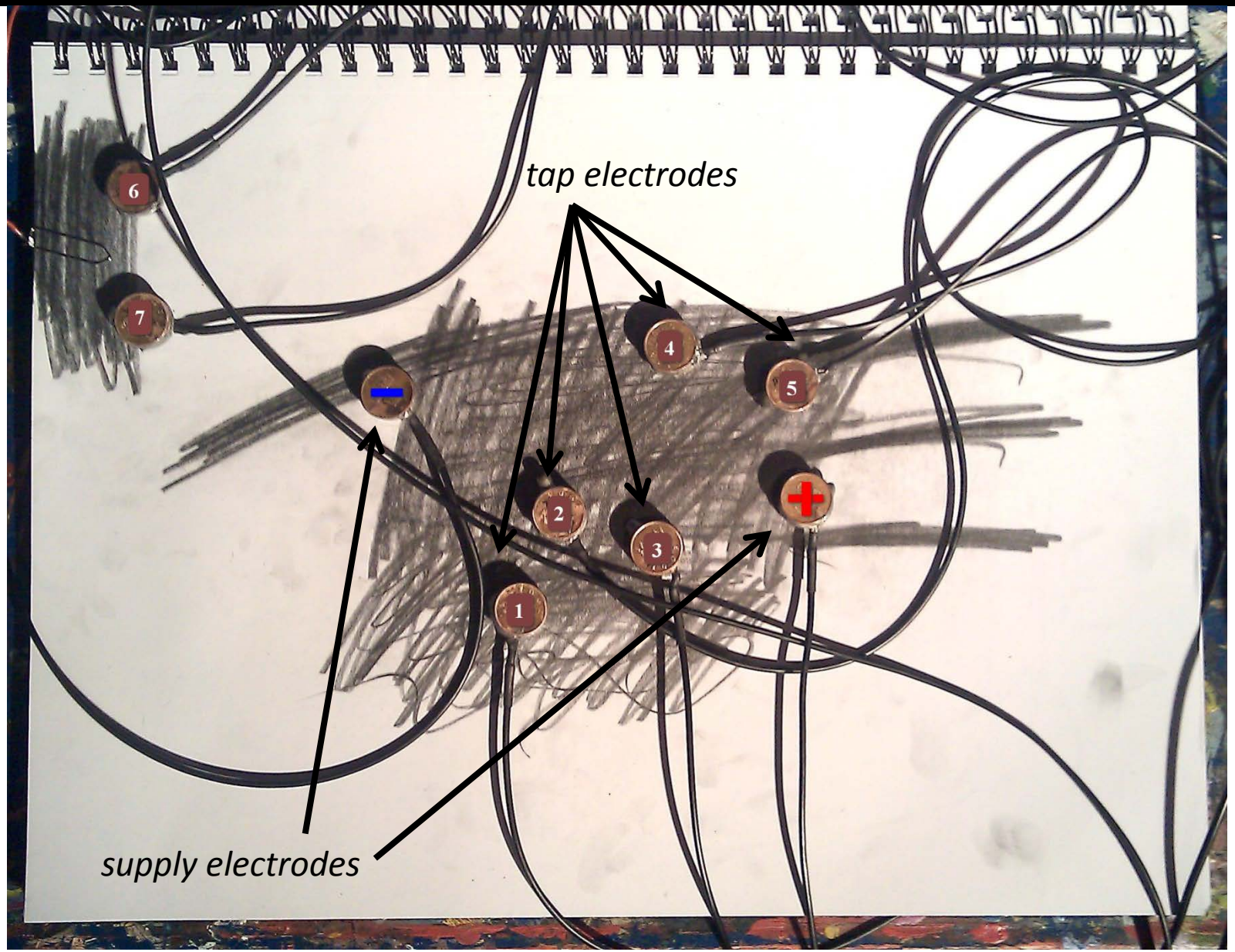
- Dynamic vectorization control->synthesis
  - as a way to gesturally explore a parameter space
- exPressure Pad (duo pantoMorf)
  - multiple FSRs
- Percussion instruments
  - pitched
  - non-pitched
- Keyboard – the Augmented Piano
- *(supershort video snippets)*

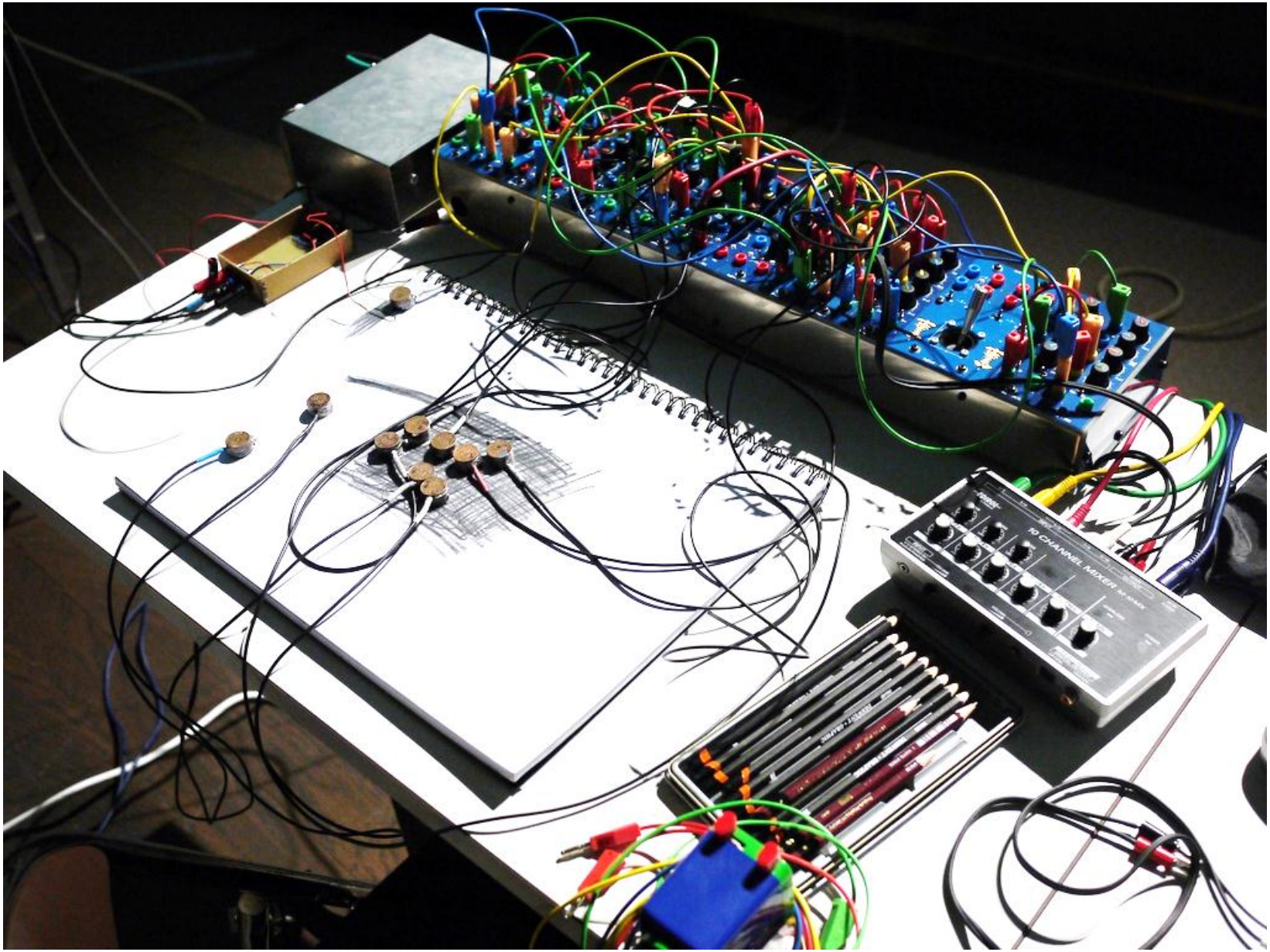
Conclusions from this research

- Coupled mappings are great (as in acoustic instr./Hunt & Wanderley , etc)
- Extreme approach: ***Non-designed all-to-all mappings***
  - initially randomized vectorization of multiple control parameters
- Dynamic mappings – can be changed on-the-fly based on discoveries
- Equals a continuous version of a one-parent evolutionary algorithm
- Play by ear
  - develop a musical meta-ear
  - parallelogram principle (McAdams & Cunible 1992)
- High degree of control and freedom, no presets
- Fader/knob control of morphological parameters
- Skill – we've been playing the same instrument for more than five years
  - duo pantoMorf
  - Used in performances with Evan Parker, David Wessel, Mats Gustafsson, John Tilbury, etc.
- Still discover new sounds and ways of playing

Pencil Fields - concept

- Create a movable 2D voltage potential field in a pencil drawing
- Tap different control voltages from this field
- Use those voltages to control analog synthesis
- Move the field supply electrodes to change the mapping
- Move the tap electrodes to vary individual voltages


tap electrodes
6
7
4
5
2
3
1
supply electrodes


10 CHANNEL MIXER

Previous art…

- 2D surfaces
  - Xenakis' UPIC, Hyperprism, KAOSS pads, iPAD apps
- Draw your interface – conservative physicality
  - Faders and knobs on paper, using projectors and cameras (SketchSynth/Billy Keyes)
- Draw your music – the lure of synaesthesia
  - Metasynth, iamge as sonogram, etc.
- The sound of drawing
  - Gerhard Rühm's *Bleitstiftmusik (1981)* – the sound of drawing with a pencil (cassette + drawings)

Previous art…

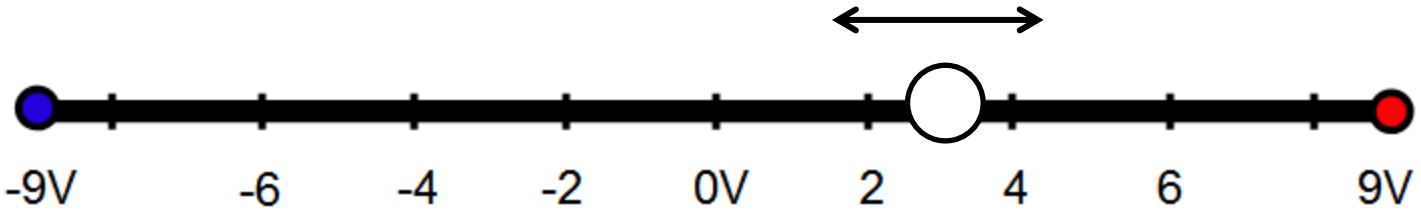
- Using pencil markings
  - Daniel Skoglund – rotating copper brush on paper as a kind of feedback sequencer
  - Drawdio (Jay Silver) – oscillator circuit on pencil, pitch controlled by resistance between finger and pencil
  - Joyce Hinterding (AU) - large graphite antennas, explored by visitors

SAFETY NOTICE

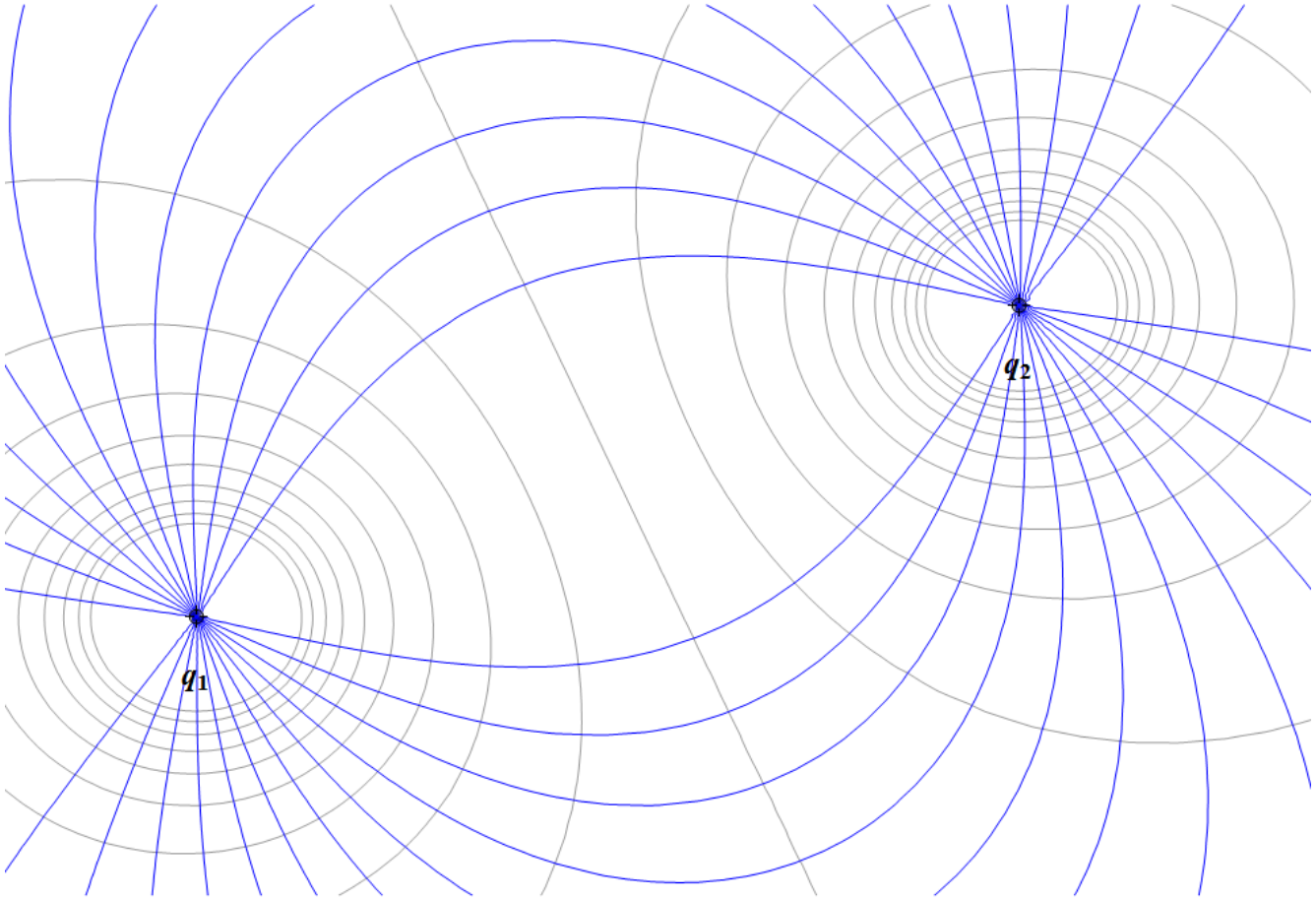
Try this at your own risk!

If you don't know what you're doing - don't do it!

I am not responsible for any damage, *material*, *physiological* or *psychiatric*, caused by your experiments based on my ideas!

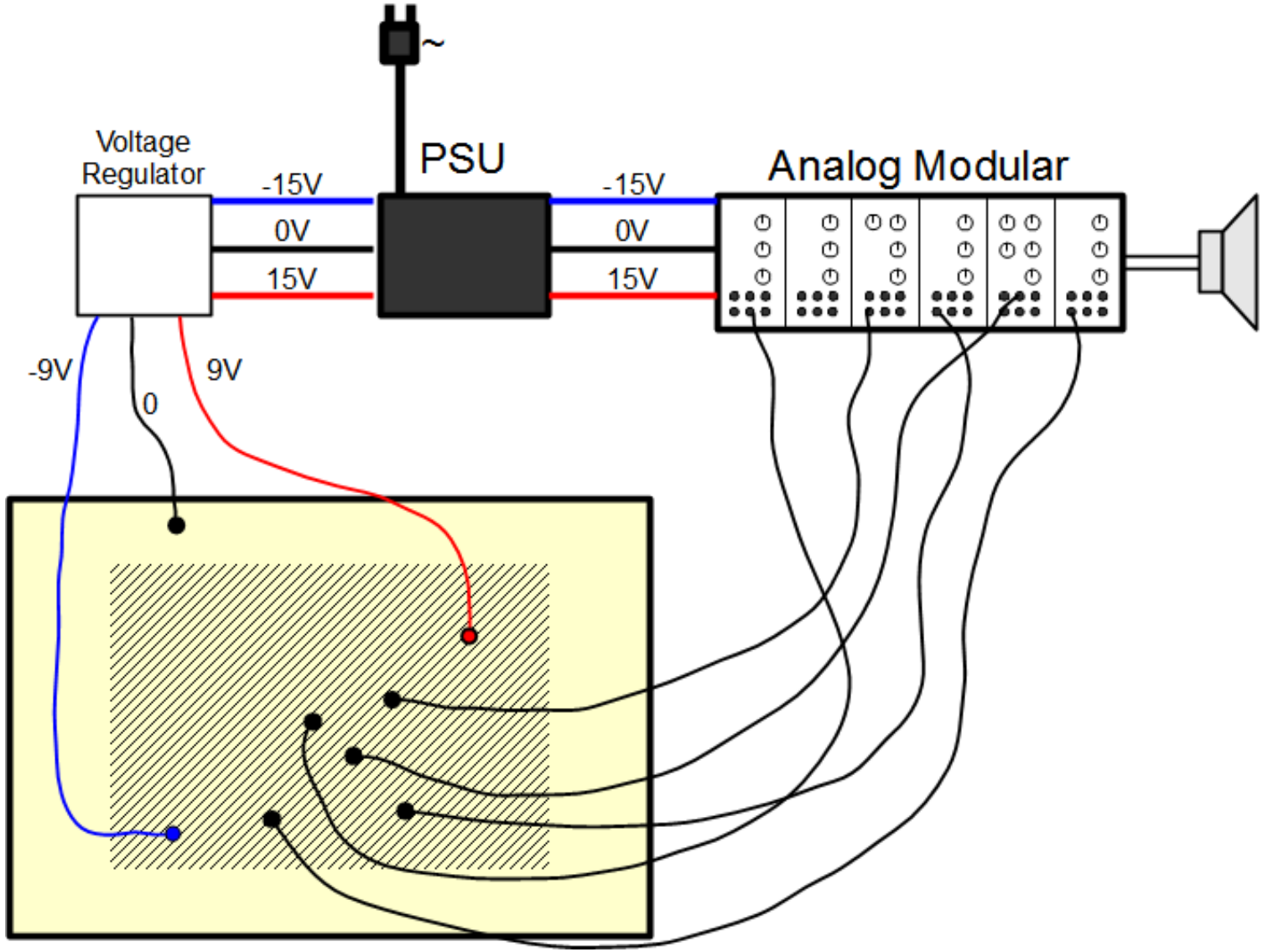


1-dimensional linear voltage divider – a potentiometer



2D voltage potential field

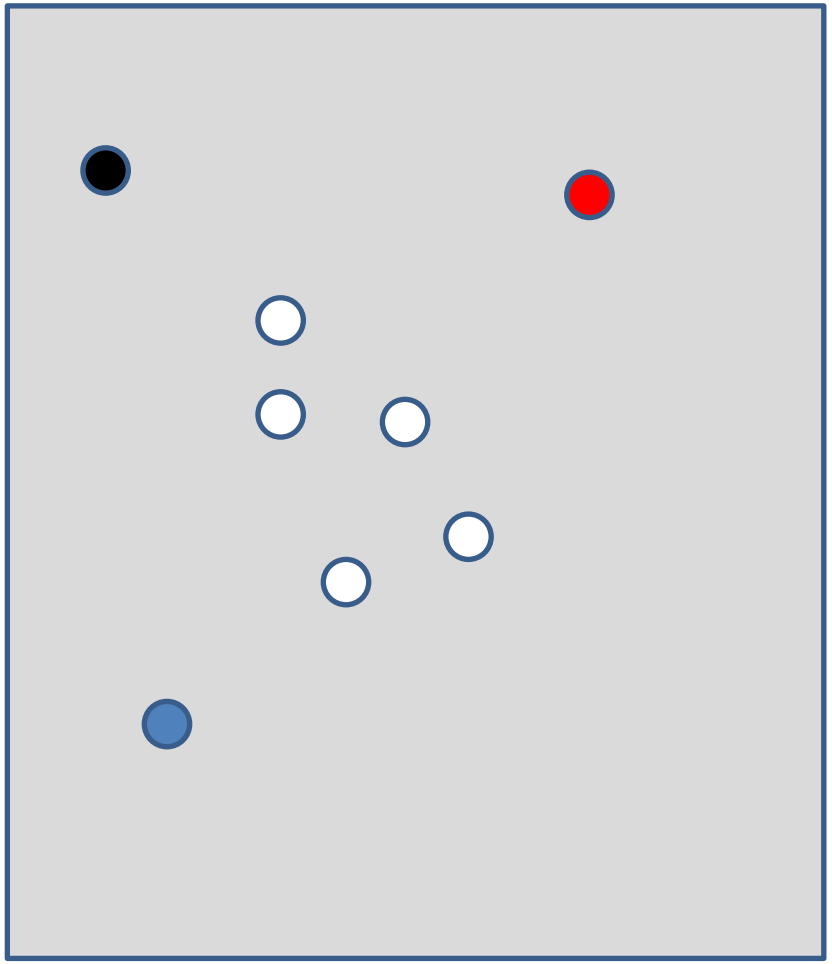
q1 and *q2* are two equal charges of opposite polarity. The gray lines show equipotential, i.e., constant voltage. The straight line in the middle shows 0V.


~
PSU
Voltage Regulator
-15V
0V
15V
-15V
0V
15V
Analog Modular
-9V
0
9V

– Video example….

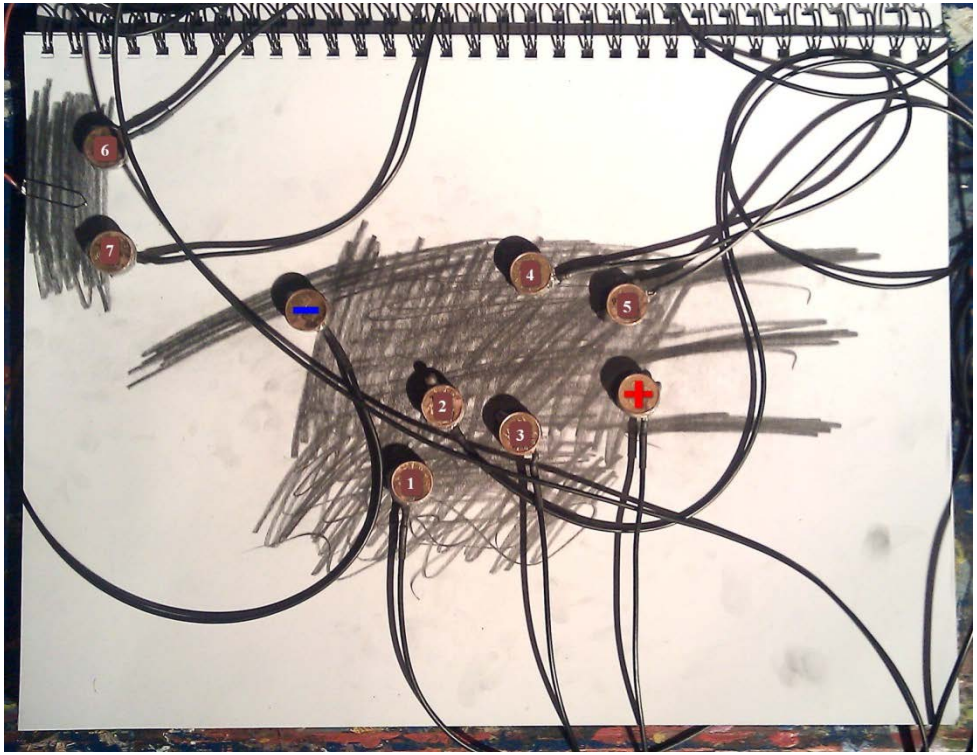
Playing techniques

- Tapping
  - Moving electrodes
- Moving the field
  - Scaling & shifting
  - Rotating
  - Warping
  - Jumping



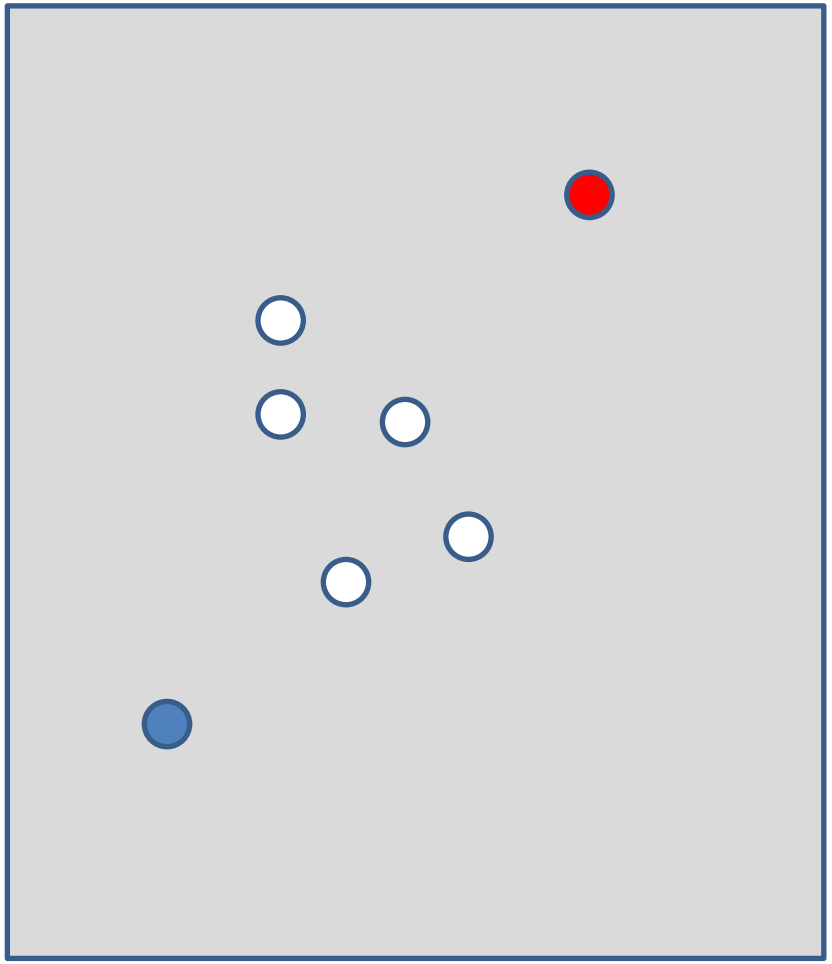
Playing techniques

- Tapping
  - Moving electrodes
- Moving the field
  - Scaling & shifting
  - Rotating
  - Warping
  - Jumping
- Ladders & tails



Playing techniques

- Shorting
  - Electrode to electrode
  - Changes the field
  - Jumps parameters
- Body contact
- Pressure
- Electrical disturbances
  - Inject LFOs etc

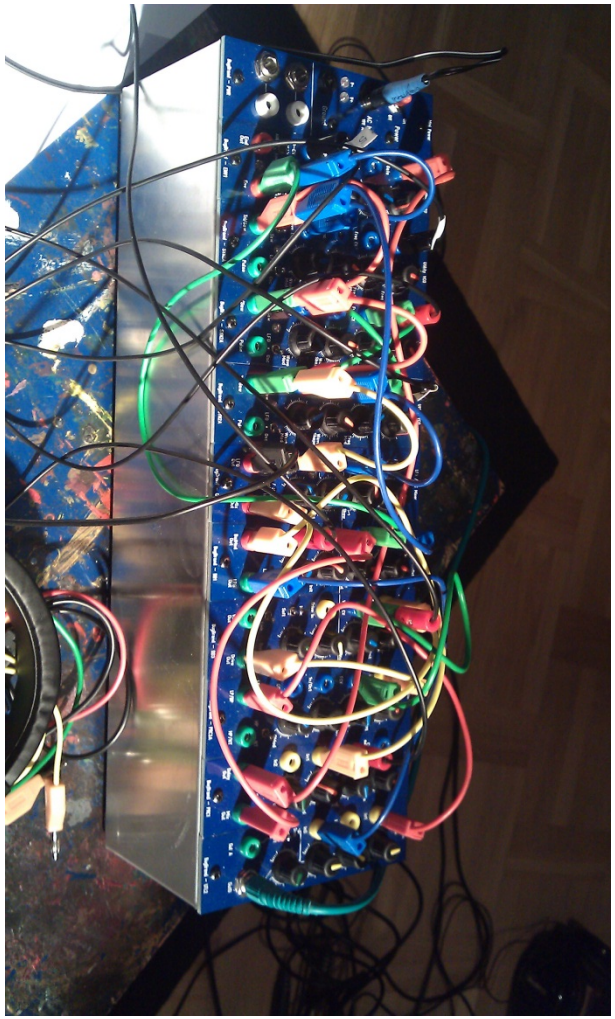


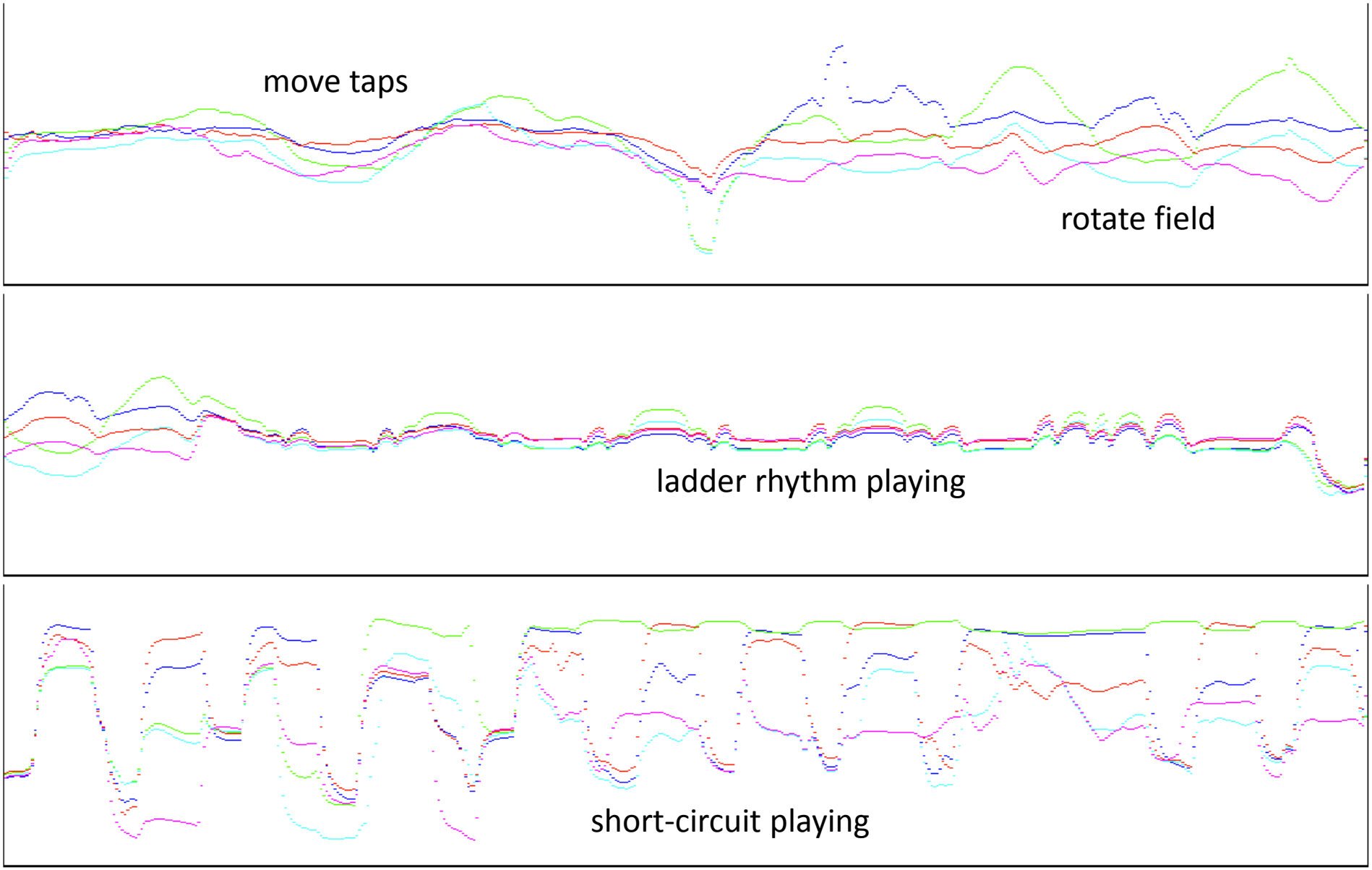
Theatrical playing techniques

- Tilt/hit/shake the drawing pad
  - Mutate/randomize parameters
- Drop/bounce electrodes
- Springiness of cables
- Build towers with electrodes
  - Like toy blocks
  - Shortings/jumps in parameters

Sound engines

- Subjective – generic
- 3 or 4 parallel sounding structures
  - simle stuff!
  - dedicated or shared tap electrodes
- Typical examples
  - cross-modulating oscillators
  - ugly-delay feedback thru filter
  - 2D wavetable lookup synthesis
- Amplitude
  - sometimes “played”
  - controlled by a dedicated tap electrode for amplitude/Buchla-style low-pass-gate
  - sometimes fixed/external mixer




move taps
rotate field
ladder rhythm playing
short-circuit playing

Discussion

- Difficult to replicate on a multitouch screen.
- The mapping is dynamic – you play the mapping itself.
- Directness and intimacy.
- Can achieve any parameter combination (in theory) but that's not the point. You do not control a number of independent parameters. You play an instrument, using your fingers and your ears.
- The physical inter-dependencies between the parameters force you to and simple and elegant solutions, and to respond directly to what you play.
- The whole construction is dirty (literally) and involves very basic materials, which is also a welcome change to the sometimes sterile digital world of electronic music.

- **All design choices have aesthetic implications!**
  - **Electrode shape & wieght, cable stiffness, paper friction**

Performance elements

- Like a board game – visual and geographic
- Big and small gestures
- Draw the pencil fields as part of performance
- Sharpen the pencil
- Interaction with physical materials (cables etc)
- Contact mics on the sharpener, on the paper

Not so good…

- Control signals can be noisy
- Contact electrode-graphite is unreliable
- Pencil markings wear out
- Unpredictable

Good…

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- Contact electrode-graphite is unreliable
- Pencil markings wear out
- Unpredictable

…because constraints make the instrument

Also….

- Flexible and expressive
- Diverse playing techniques
- Generic (any sound engine)

Future

- More advanced electronical solution
  - buffered
  - better electrical safety (especially important in this country)
- Audio manipulation
  - already done, to a certain extent
  - signal mixing, feedback control
  - but CVs are conceptually better suitable, I think
- Work more with figurative drawings
- Digital version
  - built in AD converters
  - easy to implement

- Experiment with solid resistive surfaces (robustness, productification)
  - Conductive fabric
  - Conductive paint (graphite-based)

Creative Performance

- Creative Performance (2011-2014)
  - technologies for realtime exploration of sound spaces
  - computer-mediated interaction models
  - autonomous co-players
  - interactive environments for audience creativity

- funded by the Swedish Research Council

…thank you!

Also thanks to Tom Bugs and Richard Quirk!