JOLI'N LAB
Pedro Ferragut, Federico Intrisano

DIY class: avalanche based oscillators

subject

Prototype, test and mix of a standalone analogue synth with 5 independent oscillators based on the reverse avalanche method of bipolar transistors.

lecture

The workshop will be divided into three phases:

1. We'll introduce the theory underlying bipolar transistors and their application on audible sound waves. Afterwards the circuit will be shown and every single component will be illustrated in detail.
2. The second phase, of practical nature, involves the construction and the testing on breadboards of the oscillators with all the participants. General and individual instructions will be given if difficulties arise.
   Not needing soldering iron, cutter and power supply the difficulty will be easy and the security assured.
3. Once the avalanche synths have been assembled and tested with the supplied headphones, we will proceed with the patching phase. Each breadboard is independent but can interact with the others thanks to jumper cables to make this part an intriguing group work of experimentation.

feature

The purpose of the workshop is to bring students closer to circuit design in a simple but effective way.
Hardware development is unfortunately often seen as a preclusive and difficult topic. With this experience we would like to inspire the participants to get their hands on the most common electronic components used in analog sound-making.
In this way a volatile concept like sound can be turned into something really concrete that you can take home to continue playing and experiment without any other materials in an open environment (solderless).

The principle behind the oscillators is the quantum avalanche effect.
This phenomenon occurs thanks to the reverse polarization of a transistor that, if subjected to a strong electric field, causes the electrons to accelerate. The direct current is increased and reduced periodically, thanks also to diodes and capacitors.
The diodes allow the current to pass up to a certain threshold values and the capacitors generate a sawtooth wave through loading voltage at a certain speed depending on their values.
This way we can obtain different frequency values and different tone heights with diverse diodes and capacitors. The waveform of a single oscillator, unfiltered, is basically a sawtooth.

In the workshop we'll create five oscillators with different values of capacitors and diodes, mixing the output of each oscillator with the others. Voltage input value is regulated by a potentiometer (or a LDR) for each oscillator. This technique creates an audible variation of tone and pitch that influences all the oscillators.

Thanks to the breadboard design, the individual oscillators can be patched in different forms:

- summing or subtracting the output signals with another output signal (after the emitter)
- summing the output signal with the input signal of another oscillator (before the collector) and then controlling the input voltage as a potentiometer.

With this scheme you can create complex waveforms and intricate systems that can vary different parameters randomly on their own. All this is made possible in a fully analog environment.

outlooks

Possible developments

- Transistors in quantum avalanche mode (negistor) connected in a continuous oscillation cycle generate other unpredictable and communicative subtractive waves (due to the charge / discharge / recharge cycle between emitter and collector). You can theoretically have machines that do not need external manipulations to generate true random harmonic cycles.

materials

List of essentials for 9 people (or multiple of 9)

- Amazon[1]
  Bbreadboards, 9volt batteries, potentiometers, led/capacitor/resistance kit, transistors, LDR and a tiny mono earphone
- Thonk
  PJ398SM breadboard-ready jacks

contacts

- web ⇒ www.jolinlab.com
- email ⇒ jolinlab@gmail.com
- instagram ⇒ Jolin Lab / @jolinlab
- skype ⇒ live:jolinlab

[1] we have chosen amazon (and not mouser) to bring people even closer to the concept of creating tangible music with simple and easy to find objects, without any paranoia about components quality: something not necessary in this phase of didactic prototype development. According to our philosophy it's better to keep the prices of materials as low as possible to enforce the participation of more interested people.