UPISketch Version 1.0



Drawing Music

In his article "Les chemins de la composition musicale," published in Le compositeur et l'ordinateur, Ircam, Paris, 17-21 février 1981, Xenakis reminds us what happened around A.D. 1000:

«invention of the bi-dimensional representation of pitches versus time by the use of staves and points (Guido

d'Arezzo), three centuries before the coordinates

by Oresme and seven centuries before (1635-1637) the superb analytic geometry from Fermat and Descartes.

The common usage in Western music since the middle ages is to consider music as being a flow of sound from a certain time coordinate to another time situated later in the future. We represent it by the position of an





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Background studies

One of the main ideas behind the UPIC, was to enhance its democratization. For that purpose, the UPIC software was ported on PCs in the 90s, and in 2001 was freed from the need for a specialized sound interface. Since then and following the closure of the CEMAMu (Centre d'Etudes en Mathématiques et Automatiques Musicales, dedicated to the research and development of the UPIC), ten years of world-wide software innovations have occurred.

Starting from 2011, the CIX has intiated research about what remained in the software world- of the UPIC idea. In the nineties, apart from the UPIC, the only kind of software which would allow for such a fluidity between the act of drawing and the sound produced, were sound editing programs like ProTools. From these studies, UPIC seemed to be the only tool, forty years la-"There is no deep reason why symbolic processing should not be performed in real-time, the only reason being what we could label a 'technoloter, to combine a synthesis engine with an accurate drawing tool, algical anachronism.' In fact, advanced symbolic computation and musilowing for immediate feedback. cal representation can easily become very costly in terms of processing power, and personal computers could not stand its computational weight We could also observe that the problematics of drawing sound seuntil a few years ago. This situation has established a traditional separation that, although still lingering on, is no longer justified, since interactiquences for electroacoustic music still constituted an important (and vity is an essential performative aspect of the musical discovery process, allowing any input gesture to immediately affect a given score.' active) challenge, enough for being convinced is to see the quantity of projects engaged into this theme : HighC, IanniX, HourGlass, Agostini, A. and Ghisi, D. 2012. «Gestures, Events and Symbols in the Bach Environment». Actes des Journées d'Informatique Musicale (JIM 2012), Mons (Belgium): 247–55. Metasynth, Virage, R-PIC, Hyperupic, OpenMusic maquettes, and



Edgard Varèse, Poème électronique (1958)

canat una Lauthonor gtaveo regentiomia Cuus er paincrafita V irrus dantas fapienna simag read & conum portal benedictio offand timonial MS 1665 Toscana neumes. Italy, ca. 1000

© the Schoyen Collection event on a page with this convention that left happens before right.

This convention is already a breakthrough: you can imagine in advance an event and decide when it will happen, in the space-time interval chosen for your creation. That means that you can compose, putting things together. Still at this beginning of the 21st century, the best way to communicate to the musicians an instrumental composition might well be this old traditional Western music notation system, possibly with some minor improvements or variants.

12 Seconds " 8 Altos 8 Viol/celles 6 Contrebasses

These considerations comfirm the intuition Xenakis had when drawing his sketches for Metastaseis in 1954. Later on, in 1977, the UPIC (Unité Polyagogique Informatique du CEMAMu) was born, allowing to translate drawings directly into sounds.

The motivations for a tool such as UPIC are deeply grounded in scientific and musical traditions, as these two disciplines have always been interweaved (as Xenakis stated above).

Iannis Xenakis, Metastaseis (1954) © CIX archives

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for the analysis/synthesis programs: Audiosculpt, Spear...

All these considerations motivated the CIX to find solutions for developing new tools, bearing in mind the importance of *drawing* as part of the music composition workflow. And the act of drawing, in itself, involves multiple natural abilities. It requires the help of sight as well as touch (and in our case, also hearing). Therefore, when drawing sound matter, for the complete cognitive experience to be accomplished properly, two

topics arise: accuracy and timing. Accuracy in the interpretation of gestures should not be neglected. The onscreen representation of a hand-made drawing should be faithful, and an immediate sounding and visual feedback should be obtained by a user's action. Aspects such as the accuracy of drawing and a real-time sounding possibility according to the position of the pointer was to be a key factor. Developers in a wide range of

"The initial stages of creative design often involve sketching. Electroacoustic composition is no exception to this. Paradoxically, the technologies that enable this form of composition provide little support for the sketching process itself."

"Previous research on the compositional practices of electroacoustic composers has shown that paper-and-pen sketches often –although not always– form an integral part of the process, despite this population being highly technically literate [9]. In this small survey 75% of the composers reported using pen and paper in the first stages of composition. The most commonly reported initial representation of a piece was a drawing (50%). "

Thiebault, J.-B. 2008. «Drawing Electroacoustic Music». Proceedings of the International Computer Music Conference (ICMC 2008). Queen Mary, University of London.

software technologies rather focus their preoccupations on user interface feedback.

Specificities

Foresights



UPISketch, an open-source application programmed in C++, is based upon JUCE, an open-source library that simplifies the realization of cross-platform audio applications. It is available currently on iOS devices. It is designed to be usable by children, as a pedagogic tool, while offering the framework for possible development towards a more professional use.

Determining the specifications for UPISketch created a first challenge, especially considering the time-frame for its realization (approximately one year). We decided on the idea of a GUI (graphical user interface) dedicated to granular synthesis. This idea came from the fact that the size of the waveforms used in the original UPIC were quite limited (due to realistic hardware restrictions at that time). We also wanted to address pitch and time editing in as fluid a manner as possible. In UPISketch, we opt to use pre-recorded source sounds whose durations are typically those of a musical phrase, or even just a note. Having selected one of these source sounds in the file chooser, one can directly draw and constrain its pitch in an absolute way, in the open space of the page. Time and/or pitch expansion is applied according to the parameters of the drawn gesture. This way we can manipulate rich sounds, with their own natural (or artificial) evolution.

UPISketch screen capture

When a sound is drawn, several processes start:

First, the fundamental pitch of the sound is estimated, producing a list of markers corresponding to the analysed periods.

Then the freehand drawing will produce its own list of write markers, for periods that will be therefore arbitrary.

The work will consists after that in putting into correspondence the write markers with the read markers, in order to extract sound grains from the source sound, and to distribute them in a new fashion. Here, we used the PSOLA (Pitch Syn-

chronous Overlap and Add) algorithm. It is therefore recommended that the basic material is made up of monophonic sounds, for which the pitch is clearly defined,

otherwise the results may be unpredictable.



Currently, some features that might be of interest are: The accuracy to which we can apply pitch modifications; the possibility of using guides, with alternative divisions of the octave, and representation of pitch either in midics, standard notation or frequency.

An important future can be foreseen for two aspects of drawing sound.

One is concerned the most basic aspects of the drawing experience, that can be seen as a continuous improvement of what was implemented in the UPIC, and we intended to pursue this tradition with UPISketch. The other consists of incorporating new ideas.

Furthermore, we intend to pursue subsequent versions of UPISketch, enabling it to evolve from a simple graphical score composer to an intuitive editor for the various kinds of parameters that granular synthesis naturally allows. But before this, all the following basic functionalities still need to be implemented!

- Improve the pitch analysis and synthesis implementation;
- Cross-platform: provide versions for OSX, Windows and Android;
- Soloing a gesture: ability to monitor only specified gestures;
- Layers: the ability to assign gestures to specific layers to ease the edition of groups of gestures;
- Curves for amplitude: with a pressure sensitive stylus, we could draw at the same time the pitch and the amplitude;
- Probability curve: new curves could be added to the polycurve object, for describing the evolution of probability distributions for various parameters;
- Select, copy, move several objects simultaneously;
- Snap to grid option: so that the placement of gestures fit some predetermined grids, in either time or pitch domains;
- Tempo change: changing the page duration could imply a time rescaling of all gestures;
- Realtime monitoring of the page at playhead position;
- Gesture rotation.

" It is curious how the two inventions of Xenakis, although conceived of as complementary (fixed, hand- drawn UPIC waveforms vs. dynamic, ever-changing GENDYN ones) can both fulfill Xenakis' lifelong dream of an "Automatic Music," regardless of the fact that Xenakis himself was seemingly unaware of this being possible with his UPIC system."

Peter Hoffmann, 2009. «Music out of nothing ? A rigorous approach to algorithmic composition by Iannis Xenakis». Berlin.

Link to UPISketch demonstration video

Check out the application UPISketch on the Apple Store soon!

Acknowledgements

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