

## The Centre Iannis Xenakis's establishment at the University of Rouen

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### ABSTRACT

The Centre Iannis Xenakis is a continuation of Les Ateliers UPIC, the association founded in 1985 by Iannis Xenakis and Maurice Fleuret, to promote the machine for composing music by drawing, invented by Iannis Xenakis in 1977, called UPIC (Unité Polyagogique Informatique du CEMAMu). Since December 2010, the University of Rouen (France) welcomes the Centre Iannis Xenakis (CIX) on its premises. Under the auspices of the GRHIS (History Research Lab), the CIX has placed its archives on the shelves of the University's Library and connected its UPIC machines on the premises of the Maison de l'Université (MDU, Scientific Culture pole).

In addition to the conservation work, digitizing, cataloging and the valorization of 40 linear meters of its archives, the CIX is home to the latest version of the UPIC (2001) and continues to develop its software version (the UPIX).

### 1. INTRODUCTION

After mentioning some historical milestones around the Iannis Xenakis's UPIC, the librarianship specificities of Centre Iannis Xenakis's archives will be discussed (heterogeneous supports, problems around digitizing no longer current media, standardized description of metadata, publication of archives on the web through Omeka). Finally, the promotional activities around the archives and the UPIC since the CIX's installation at the Université de Rouen will be highlighted (organization of conferences and electroacoustic concerts, pedagogical activities, UPIC workshops, the creation of a new itinerant exhibition, some recent archive-based research, and an overview of new developments of UPIC's software version will be discussed).

### 2. HISTORICAL MILESTONES AROUND THE UPIC

"Music, and the arts in general, are the supreme way of exercising human creativity, and must start as soon as possible and continue until the end of one's life." [1]

This phrase, taken from an interview by Iannis Xenakis, stresses the importance Xenakis gives, as early as 1970, to rethink teaching, adapting it to new ways of composing and thinking about music. However, this wish will only be possible by designing a tool capable of overcoming cultural barriers related to traditional ways of learning music. In addition to allowing the greatest number of people access to music composition, this tool would be able to integrate music deeply into social activity [1]. This is one reason why Iannis Xenakis had, since the 1950s, the intuition to develop a machine allowing him to break free from the constraints of traditional western music notation, while simplifying the exploration of innovative compositional processes. Comprising, in its first version, a large graphic table, a magnetic pen, and an interface for calculating sound signals, the UPIC allows the composer to visually design and draw all the elements of her/his work, from the micro to the macro form, by combining in a single machine both formal design and sound synthesis. From the creation of the UPIC prototype, Iannis Xenakis perceived multiple pedagogic possibilities for this tool. With the UPIC it became possible to develop a new pedagogical approach to musical composition not focusing on tedious learning, but on empirical notions based on pure experimentation [2]. The first fully functional UPIC station was born in the CEMAMu (Centre d'Études de Mathématique et Automatique Musicales) which developed its design from 1968 until 2001: this research led to different versions of the UPIC (UPIC A in 1977, UPIC B in 1983, UPIC C in 1987, etc.) to produce a PC version in 1991 and a software version in 2001.

In 1985, the French Ministry of Culture, under the auspices of Maurice Fleuret, decided to create, with Iannis Xenakis, Les Ateliers UPIC. Working in conjunction with the CEMAMu, this organization's mission was to

ensure (under the management of Alain Després, appointed artistic director) the promotion of, the initiation to, and presentation of the UPIC to a wide audience. François-Bernard Mâche (composer and longtime friend of Xenakis) was appointed president of the association. In 1987, Iannis Xenakis requested the Ateliers UPIC to develop, in parallel to their promotional activities, creation studio (for the production of new works) and a pedagogic cursus: two studios of composition were held in April 1987 at Le Parc de la Villette, in Paris. Concerning 1987 alone, the Centre Iannis Xenakis's archives reveal that Les Ateliers UPIC welcomed composers with aesthetic backgrounds as diverse as Pierre Bernard, François-Bernard Mâche, James Harley, Peter Nelson, Julio Estrada, Jean-Claude Eloy and Alain Lithaud. In the 1990s, the UPIC system fascinated a new generation of composers such as Brigitte Robindoré, Takehito Shimazu, Nicola Cisternino, Gerard Pape, Jean-Claude Risset, Daniel Teruggi and others. At that time, the real-time version was fully usable, the computer screen and mouse gradually replaced the drawing table and the electromagnetic pen, and the UPIC was adapted in 1991 to the Windows system.

In 2000, at the initiative of Gerard Pape, the last director to date, Les Ateliers UPIC were renamed the Centre de Composition Musicale Iannis Xenakis (CCMIX). Indeed, the association had expanded its mission to teaching and composition in a broader sense: by developing a program of music research (allying science, mathematics and electroacoustics), an activity of music composition, and several courses where the UPIC was no longer the sole focal point. By engaging the CCMIX in this direction, Gerard Pape revealed that besides interest and curiosity aroused by the discovery of the machine, the UPIC, and tools associated with it were possible vectors, among other media for music composition. For Gerard Pape, the UPIC is a driving force for individual creativity, unable to suggest a sum of standardized proposals, but which, by its flexibility, fully reveals the creative potential of its user [3].

In 2007, in response to an audit by the French Ministry of Culture, the CCMIX's former team was replaced by a new team (the CIX) whose mission became to "redefine the goals of the association, focusing on the preservation, promotion and dissemination of the intellectual legacy of Iannis Xenakis's work."

### **3. THE ARCHIVES OF CENTRE IANNIS XENAKIS**

Considering the incredible vitality of the center for music composition for twenty-five years (around 130 composers have worked in connection with the association), it is logical that the documentary sources of its archives are exceptionally rich and varied. The 40 linear meters of

archives were deposited in April 2011 in the Library of the Université de Rouen.

Currently, the archive has three main legs: in addition to the archives of the center itself, a few boxes of correspondence, press and program notes (belonging to Sharon Kanach's digitized personal archives which actively continues to grow) form a second bequest. The artist Bruno Rastoin also gave the CIX many of his personal xenakian archives, including images he photographed during the installation of Diatope at Beaubourg in 1978 and in Bonn in 1979. As the knowledge and reputation of the CIX archives grow, so do its bequests. Recently, to cite one example, sound engineer Dick Lucas has donated rare iconographic documents from his personal archives regarding the reconstruction of the Philips Pavilion in Eindhoven in 1984.

After the initial pre-inventory step (2012: filing of the collections under appropriate conservation conditions in standard boxes protecting documents from light and dust), the CIX, under the aegis of GRHIS (History Research Lab at the Université de Rouen) has obtained the support of the French Ministry of Culture and Communication as part of the national digitization program.

#### **3.1 The paper Archives**

With eleven linear meters, representing around 60,000 pages, paper archives constitute one third of the collection. It is possible to make a typology:

- The paper archives (6 linear meters), which are grouped under generic names: letters, emails, courses notes, research notes, drafts, etc.
- Hardware and software documentation (2 linear meters).
- Newspaper articles (1 linear meter).
- Program notes (about 1 linear meter).
- And finally, the digital archive of Sharon Kanach's bequest that currently represents approximately 1 meter.

#### **3.2 Sheet music and printed material**

The center has 450 scores/sheet music, most of which are unpublished. At the current state of research, we can surmise that most of these come from calls for candidates for courses in music composition, organized by the center. Only some of them, especially the graphic scores and scores of composers in residence, were written specifically at the center.

As for printed documents, it is often academic work, whose subjects focus on the center's research activities or on the UPIC system: of particular note is the presence of the Julio Estrada's doctoral thesis in musicology.

#### **3.3 Multimedia material**

Multimedia supports (3500 items) account for 55% of the archives. Although this collection is heterogeneous, audio

documents constitute the majority. If we do not take into account the vinyl records, cassettes and published compact discs (which certainly represented the music library of the Centre), other sources (such as digital audio tape (DAT), tapes and engraved cds) are mainly unpublished documents. This is a unique collection of recordings which includes concerts, sound banks used by electroacoustic composers, and probably completed unpublished works. As we pursue cataloging, indexing and digitizing these documents, we will learn more.

Iconographic sources also play an important role: photographs, for example, often reveal a documentary attractiveness as portraits of composers in action, or a few shots of concerts.

Although video sources are not very numerous, they are nevertheless very relevant: they may include documentaries for internal or promotional use, as well as unprecedented film captures of concerts.

Finally, the archives contain many out-dated media, whose reading and digitizing are not possible today without compatible machines: how to extract and save in a sustainable manner the data on these old media carriers, such as floppy disks, Syquest cartridges, QIC cartridges or other data cartridges even older?

### 3.4 Digitization of archives for preservation

Thanks to the national digitization program of the French Ministry of Culture, the CIX has begun digitizing its collections for preservation. Currently most of the multimedia sources are digitized (except for old unreadable media carriers), but much of the paper records is not. 534 burned compact discs and 80 ¼ inch magnetic tapes were digitized first, due to their fragility. Oversized papers (scores, posters) have been entrusted to the digitizing company Arkhênum while DAT and photographs from Rastoin's legs were entrusted to Hammersnail (Daniel Teige's company). In addition, Sharon Kanach's bequest was fully digitized by the Cyrille Delhaye and Julie Graine (as part of an internship at the GRHIS).

### 3.5 Valorization activities: digitized archives online

In addition to the permanent conservation of documents, the national digitization program aims to digitize, index and disseminate the archives of its recipients, including the CIX, via the internet. For this purpose a partnership was established with the Portail de la Musique Contemporaine to promote the data and metadata from our digital collections. Other international partnerships are already planned. The digitization and online resources will facilitate the dissemination of works created and archived at the CIX, as well as the creative processes associated with them, to a wide public. All such data will be available under conditions protecting the intellectual property of their authors and assignees, according to the agreements negotiated by the Portal's collective rights management agreements (broadcasting compressed image formats,

extracts limitations, streaming compressed format for audio and video, etc.). However, such endeavors give rise to pertinent questions of library science that are governed by a certain number of constraints:

- These archives are very heterogeneous, making their description difficult. The cataloging software used must natively integrate some flexibility in the capture of metadata. For example, such a tool should support the notion of "forged title" because many documents bear no intelligible titles. Hundreds of burned compact discs and dozens of magnetic tapes on which only the composer name appears, are a prime example.

- The contemporary music Portal proposes to "harvest" our metadata for incorporation into its own database and thereby mutually increase visibility on the web. However, this Portal harvests metadata from its partners in a revised MODS format (MODS is changed by gateway administrators) through OAI-PMH (Open Archives Initiative Protocol Metadata Harvesting). The MODS format (Metadata Object Description Standard) is a set of normalized metadata developed by the Library of Congress. This set of metadata enables the capabilities of the Dublin Core format to be extended by describing each item more precisely (by adding xml containers such subtitle, place of registration, date of creation, etc.). Subsequently, these constraints led the CIX to turn towards the digital library platform Omeka. It is freeware under the GPL, developed by Roy Roszenweig for History and New Media. This platform is part of the movement of digital humanities and is used, for example, by the Library of Congress and by the Europeana gateway.

The main characteristic of Omeka is to be easy to handle. Its principle is simple: the CMS manages "items" that can be attached to a collection. Each item that can be compared to a catalog record is described natively in Dublin Core and is connected to one or more digitized documents. Finer technical data can be added in sets of metadata that are not harvestable. A system of tagging indexes the items and allows for flexible navigation between collections. Omeka allows (via a plugin) to disseminate the metadata via OIA-PMH protocol after conversion of metadata in MODS.

In addition, Omeka is a user-friendly interface and offers many services to researchers. In addition to enabling one to watch digitized archival documents online, the user can, for example, design her/his own path of research, backing it up on her/his account, and exporting this tracking as a poster. Other features of this platform including be able to set values for items through the creation of virtual exhibitions, opportunities to leave comments or even, curation by registered users (crowdsourcing).

## 4. CENTRE IANNIS XENAKIS'S ACTIVITIES

The second part of the project initiated at the University of Rouen by the CIX recognizes the prestigious past of Les Ateliers UPIC/CCMIX: to restore and promote the technical heritage of this center for music composition and research. Thanks to the intervention of Rodolphe Bourotte (composer and founding member of the CIX) all the studio audio equipment has been inventoried and maintained. This step has allowed us to reconstruct a complete studio for composing electroacoustic music, currently housed at the Maison de l'Université (Scientific culture pole).

According to tests conducted by Rodolphe Bourotte, two UPIC units of the four recovered are functional. Recently Sharon Kanach (Vice-President of CIX) has tracked down a UPIC A at the University of Strasbourg, purchased by the Primus Center when François-Bernard Mâche created that there in the late 1980s. The next phase of the project is to restore the large graphic tables of the first version of the UPIC.

Another original UPIC has recently been discovered in Athens at the Ksyme Center (originally founded by Iannis Xenakis in 1979) and we look forward to future collaborations with our "Greek cousins"!

Moreover, UPIX, the software for music composition through drawing (whose basic functions and ergonomics are based on those of the original UPIC) has also enjoyed a brilliant career, both as a tool for artistic creation and as a pedagogic tool. Seeing the potential this concept still has in the XXI<sup>st</sup> century, both in terms of audience development and in terms of facilitating access to unprecedented creative modes to all sorts of publics, the CIX decided to resume its development. Subsequent to being updated in 2013-14 (for the first time since the composer's death in 2001) this software is now cross-platform. It is now possible to further its development and incorporate both new functions anticipated by Xenakis himself as well as integrate others, now available and desirable, taking advantage of the most recent evolutions in computer science (3D, physical modeling, interacting particle systems, etc.). These ameliorations are henceforth the essential goals of our research.

### **The UPIX project's guidelines**

From the start, engaging in such a project raised the question of what innovations are necessary and possible to add. Our first step was to gather and take these into consideration. Some such elements that came to us spontaneously were managing probabilistic events as well as Xenakis's "sieve theory". With the UPIC, everything was based on drawing, so it became pertinent to find a way to graphically express these new types of events and treatments. A previous attempt at creating probabilistic drawing for generating sound was realized with MAX/MSP<sup>1</sup>. This draft project provided us with an idea of how UPIX could be transformed to become a system able to generate clouds of probabilistic grains, providing adequate draw-

ing tools. In addition, a new implementation of GEN-DYN is envisaged, which could apply these same principles to waveforms.

Preliminary discussions therefore were of a hybrid character, involving both the existing features of UPIX 2001 and the new ones CIX wanted to further develop. The goal always remains the same: at all costs, maintain the evolutionary aspect of the software and avoid blocking its future development by limiting the scope to the simple reproduction of its 2001 functions.

We also had to consider the team's workload capacity over an academic year and therefore had to establish priorities. The choices made correspond to the research of sound composition software through drawing initiated in 2010 by Rodolphe Bourotte in 2010<sup>2</sup>. It is not and should not be a question of starting from scratch from the UPIC's basic concept, indeed considered robust unto itself, but rather to reconstruct a dynamic, evolving tool based on it.

The first phase's development team included seven students from the Université de Rouen in software engineering, overseen by their professor<sup>3</sup>. The approach the department takes is to create a simulation of a corporate client. Accordingly, Rodolphe Bourotte, who supervises this project for the CIX was considered their "client". The project was defined over four phases: from the Definition of Technical Specifications, to creating the Basic Elements of the graphic interface, to developing the UPIC-specific characteristics, to the Final Delivery (although certain functions had to be postponed until the 2014-15 session due to time constraints). All in all, the result is highly satisfactory, providing a solid software architecture, well documented, which will enable us to move forward smoothly in the future.

### **Other research underway**

Mentioned earlier, internal video documentaries made by Les Ateliers UPIC and/or the CCMIX were the starting point for a new research project by Sharon Kanach, where unpublished and unprecedented filmed testimony by Xenakis himself was discovered in our archives. This ongoing project has already yielded an astounding number of films directly involving Xenakis, found through various other archives and sources as well. To date, some 139 films can be linked to the composer, a number that approaches the same as his catalogue of compositions as well as the same number of articles he penned. A whole new side of Xenakis is being unveiled, thanks to the impetus of these hidden gems surfacing through our inventory process...

In 2012, the CIX was invited by the ZKM to mount an exhibition around the UPIC for the vast Sound Art Exhibit at the Karlsruhe institution hosted on its premises. "Iannis

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<sup>2</sup> See Reference 4.

<sup>3</sup> UPIX 2014 version 1.0, by the team Master 1 GIL 2013-2014 à l'Université de Rouen: Maxime Angot; Thomas Grenier; Virginie Le Balch; Quentin Lefebvre; Margot Racine; Marcellin Rwego; Ayoub Saadi; and their professor Stéphane Hérouville.

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<sup>1</sup> ProbaPainter, 2011, <http://rodolphebourotte.blogspot.fr/2011/08/proba-painter-demo.html>

Xenakis and the UPIC” was curated by Cyrille Delhaye, Rodolphe Bourotte, and Daniel Teige. From that, and due to third party demand, it was decided to create from the original content exhibited there a traveling exhibition (one in English, the other in French), under the same title. This was made possible thanks to a grant from the GRR (Grand Réseau de Recherche) – Université de Rouen. This exhibition is comprised and composed mainly of elements (information and iconography) discovered in the Archives of the CIX and includes:

1 title panel; 1 bio panel on Xenakis; 1 timeline (7 interactive panels including QR codes for "smartphones) tracing, on the one hand the history of electroacoustic music and on the other hand, Xenakis's activities engaging the same; 1 panel representing Xenakis's 10 original sketches of *Mycènes Alpha* plus 1 panel of the "definitive score"; 4 panels on the history of the UPIC; 1 list of composers who have worked on the UPIC (circa 150 names); 1 listening station showing a film on the UPIC followed by a performance with "score" of *Mycènes Alpha*; 1 other listening station with the film by Chris Marker on Xenakis and the UPIC ["The Owl's Legacy" (1989)]

In addition to such research activities and the organization of international conferences and workshops/concerts (see the list below), the CIX has organized, since 2009, a revival of workshops around the UPIC under the responsibility of Rodolphe Bourotte. This software, now considered "classic," can it still be considered a "multiplier of imagination"? Is it still a unique pedagogical tool? Many questions which these new workshops attempt to answer [4].

To date, the following workshops/events have been organized:

- A UPIC workshop in April 2011 at the Southbank Centre in London during the Ether Festival.
- At the University of Rouen, with local students, on several occasions from 2010.
- At the Zentrum für Kunst und Medientechnologie (ZKM) in Karlsruhe (Germany) during the Xenakis Symposium (July 2012), and with two school classes since.
- At the Conservatory of music in Le Havre and with students of the College of Fine Arts in Le Havre (ESADHAR) in April 2013.

For these workshops the UPIX 2001 software version was used, as well as the hardware version, whenever possible. Workshop participants have quite varied profiles, often music students or already experts in electroacoustic techniques, but also children and novices, varying from nine to sixty-five years old. These workshops provide a fertile ground for future developments of the tool, with respect to Xenakis's first ambitions for the tool. As in the 1980s, workshops generate a strong interest. Participants discover something they previously did not know, which tends to show that the idea of drawing sound is neither widespread nor natural yet, even today. It also proves that the use of the UPIC can be further extended. For instance, Andreas Köhler, who teaches music tech-

nology at ZKM, has integrated the UPIC in that Center's pedagogic activities. He particularly relates the rigor required for the user to practice the software to enhance this experience. This is echoed in the words of Peter Nelson, a longtime collaborator of Xenakis, who participated in early UPIC pedagogic activities:

"Here, no 'virtual orchestra', imagination must harness the potential of the system, whose strength is direct access to the smallest sound details, extreme simplicity of the means and speed of work. In my experience, people find it rather refreshing than daunting." [5].

## 5. LIST OF CIX'S RECENT ACTIVITIES

(When places are not mentioned, listed events were held at the Université de Rouen)

- December 15, 2010: International Symposium: "The polytopes Xenakis," in collaboration with ENSA Normandy.
- May-June 2011: pre-inventory and storage of CIX's archives.
- 24-25 June 2011: Cyrille Delhaye, presentation of CIX's archives at the International Symposium "archive :: art architecture / mediaartbase.de ZKM" (Zentrum für Kunst und Medientechnologie) in Karlsruhe (Germany).
- 07-08 December 2011: International Symposium: "Xenakis and the arts" in collaboration with ENSA Normandy, Rouen Regional Conservatory and the Université de Rouen.
- January 09, 2012: "Iannis Xenakis and UPIC machine", by Pierre-Albert Castanet, Professor at the University of Rouen, Associate Professor at the Conservatoire National Supérieur de Musique de Paris.
- 06 February 2012: "Birth of a work: *Taurhiphanie* by Iannis Xenakis" by Cyrille Delhaye, Associate Researcher GRHIS, Doctor of Musicology, responsible for the CIX Archives.
- 12 March 2012: "Xenakis and Le Corbusier" by Sharon Kanach, Vice-President of CIX, co-author with Iannis Xenakis of *Musique de l'architecture* (Marseille, Parenthèses, 2006).
- April 2011: Ateliers UPIC At Southbank Centre in London during the Ether Festival, by Rodolphe Bourotte (composer and founding member of CIX).
- 03 April 2012: concert / workshop around the UPIC: with Rodolphe Bourotte.
- February 2012: CIX obtains a grant from the DRAC (France, Haute-Normandie) for digitizing the archives of the CIX.
- March-May 2012: inventory of the archives of CIX.
- March to September 2012: Exhibition / concert / workshop around the UPIC at ZKM (Karlsruhe, Germany).
- May 28, 2012: BBC radio report around the studio and archives of the CIX.

- July 2012: UPIC workshop at ZKM (Karlsruhe, Germany) during the Xenakis symposium, Rodolphe Bourotte with two school classes.
- October 03, 2012: Commented visit of installations and archives of the CIX, by Cyrille Delhaye.
- November 05, 2012: "Serment-Orkos by Iannis Xenakis: a musico-literary approach" by Nicolas Darbon, Doctor HDR.
- December 03, 2012: Workshop / Concert around the UPIC with Rodolphe Bourotte.
- February 04, 2013: "An artist looks at the *Diatope* of Iannis Xenakis" by Bruno Rastoin.
- March 04, 2013: "Philosophical Foundations of the musical approach of Xenakis" by Mihai Iliescu.
- April 29, 2013: workshop, concert around the UPIC with Rodolphe Bourotte
- April 2013: UPIC workshop at the Music conservatory in Le Havre and with students from the College of Fine Arts from Le Havre (ESADHAR) with Rodolphe Bourotte.
- October 14, 2013: workshop concert around the UPIC with Rodolphe Bourotte.
- November 04, 2013: "Iannis Xenakis and Nature" by Benoît Gibson.
- February 05, 2014: "The implementation of the CIX at the Université de Rouen" by Cyrille Delhaye.
- April 01, 2014: "Between Charybde and Scylla, space-time and continuous variations" by Pascale Criton.
- May 07, 2014: "Outdoor electroacoustic concert", by Rodolphe Bourotte.
- October 15, 2014: "Xenakis and film" by Sharon Kachach.
- November 12, 2014: "Xenakis, mathematics and music" by Moreno Andreatta.
- December 03, 2014: "Multimedia concert" by Rodolphe Bourotte and *Les vibrants défricheurs*.

## 6. CONCLUSION

The singular approach of the research that has been conducted in this center of composition and music research has attracted composers from around the world seeking another way to compose. The archives they have left (and leave!) represent the stratification of their creative processes, generating a unique and valuable documentation. The challenge now is to maintain and ensure the dissemination of this knowledge base by sharing it with a greatest number of persons. To achieve this, digitizing documents, cataloging and formatting metadata meeting international standards for interoperability, appear to be the next stages of the project.

In addition, recent work by Rodolphe Bourotte around UPIC workshops have shown that this tool for music composition by drawing still inspires many composers, be they beginners or experienced composers. It is therefore the CIX's goal to preserve save technical heritage (UPIC) and enhance the development of its software

version the UPIX), all while encouraging independent, third party, related research.

## REFERENCES

- [1] I. Xenakis, "Grandeur et misère de la musique contemporaine," *Guide musical*, vol. 653, pp. 4-6, 1974. Digitized document. University of Rouen (France): Archives of Centre Iannis Xenakis.
- [2] I. Xenakis, "Si Dieu existait, il serait bricoleur," *Le Monde de la musique*, vol. 11, pp. 92-7, 1979. University of Rouen (France): Archives of Centre Iannis Xenakis.
- [3] G. Pape, *Projet artistique des ayeliers UPIC*, 1997. University of Rouen (France): Archives of Centre Iannis Xenakis.
- [4] R. Bourotte, C. Delhaye, "Learn to think for yourself: impelled by the UPIC to open new ways of composing", *Organised Sound*, vol. 18, no. 2, pp. 134-145, 2013.
- [5] P. Nelson, "The UPIC system as an instrument of learning", *Organised Sound*, vol. 2, no. 1, pp. 35-42, 1997.