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Musical Devices

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ixi lang: A Constraint System for Live Coding

1. Introduction

In the late 1990s a new performance practice appeared in the more experimental venues of the musical world, where performers would step onto stage with a rather strange musical instrument, the laptop. These performance contexts, in pubs and clubs, were primarily designed for pop or rock bands. Instead of locating themselves behind the mixer, where the best sound is normally to be heard, they placed their equipment on the stage, typically on a table, and presented some rather refreshing and novel musical worlds. Whilst the audience appreciated the texturally sophisticated world of sound these instruments were capable of, the performance aspect of the music suffered. What were these musicians actually doing behind these screens on the stage?

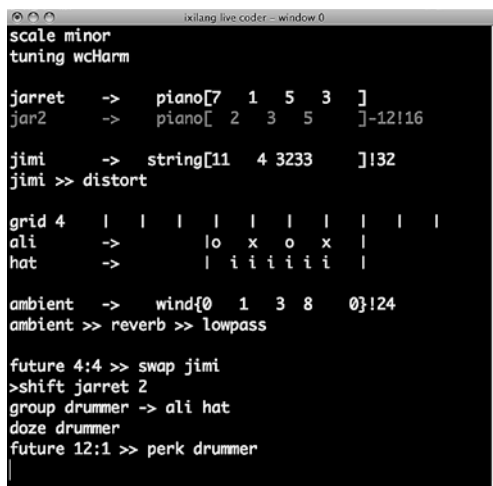
A decade later some solutions had evolved, addressing this lack of coupling between the performer's gestures and the sound emitted by the speakers. One of them is VJing. By analysing the sound signal – typically through Fast Fourier Transform Analysis or even OSC messages sent from the sound generating software – the VJ is able to generate visuals that connect and represent the sound in endless interesting, yet arbitrary, ways. Another solution is represented by a field often called NIME (New Interfaces for Musical Expression), with university courses and conferences dedicated to the investigation (see www.nime.org). Here various interfaces have been designed that allow the performer to use her body, in a manner inspired by acoustic instruments, to control a digital sound engine. The third response to the problem of the exclusiveness of computer music performance is live coding.

2. Live Coding

Live coding needs no introduction, but as a summary it comes with an imperative that performers project their screens such that the audience is able to participate in the musical creation. And this should be done from a

clean slate where the code is designed in real-time. A dedicated forum exists for practitioners (www.toplap.org) and various papers have been written with topics that range from general introductions (Collins et al. 2003), to live coding in specific systems (see Wang & Cook 2004; Rohrhuber et al. 2005; Sorensen 2005), or live coding as artistic practice (Nilson 2007; Sorensen & Brown 2007).

A typical problem for the live coder is the high level of expertise required for such performance (Nilson 2007). Very few performers are able to exhibit those skills without consistent dedication to practise (Sorensen and Brown 2007). Although I have long been fascinated by certain virtuosic live coders, it seemed to me that such incorporation of dexterity strives against the primary rationale of the mechanical computer; namely the automation of rote tasks and the augmentation of mental capacity.



```
ixi lang live coder - window 0
scale minor
tuning wcharm

jarret -> piano[7 1 5 3 ]
jar2  -> piano[ 2 3 5 ]-12!16

jimi  -> string[11 4 3233 ]132
jimi  >> distort

grid 4 | | | | | | | | | |
ali   -> |o x o x |
hat   -> | i i i i i |

ambient -> wind{0 1 3 8 0}124
ambient >> reverb >> lowpass

future 4:4 >> swap jimi
>shift jarret 2
group drummer -> ali hat
doze drummer
future 12:1 >> perk drummer
```

Fig. 1: A screenshot of an ixi lang session.

3. Design Rationale

From this perspective, I attempted to design a musical live coding language that would free performers from having to think at the level of computer science, allowing them to engage directly with music through high-level representation of musical patterns. Most importantly, the language should be easily understandable by the audience who would be able to follow each step of the performance, given a little bit of imagination in terms of interpreting language features and functions.

The ixi lang was intended to address a problem in live coding involving slow buildup times and lack of musical constraints. Too much freedom can confuse the performer. The goal was to be able to create a tune with rhythm and melody within a few seconds from the performance starting. The language should also be understandable to non-programmers who would be able to follow clearly the performer's train of thought.

4. Ixi Lang Functionality

The ixi lang has three modes of musical notation that can be generated and synchronised in real-time: melodic, percussive and concrète (sample based). These musical patterns are created in the form of identifiable agents whose performance can be adjusted through various methods (e.g., shifting notes, transposition, reversing, inverting, scrambling). Figure 1 shows a text document that serves as the code input window. The code is both as updated representation of the score (it can change according to the user's design of algorithms) and a direct instruction to the system's play mechanism (the score itself).

The ixi lang clearly affords a certain limited set of musical activities. It provides a scaffold for externalising musical thinking and through its simplicity attempts to ease the live coder's cognitive load. As a live coding system it goes further than most common live coding environments in providing a simple, high-level platform for musical improvisation. However, this is at the cost of possible expression, as height (in terms of abstraction) will always impede freedom.

5. Conclusion

The ixi lang was devised to address specific problems common in live coding performance, such as slow and laborious build-up, incomprehensibility, and difficulty in making simple musical structures. It provides the performer with a very high-level language where musical structures can be set up in a matter of seconds using a syntax that is intuitive and easily understandable to audience. With user comments such as (Magnusson 2010):

- “Wonderful to break free from the rigid time line approach.”
- “The audience can immediately participate in the performance. The language is general and simple. At times funny to watch.”
- “A release from the paralysis of choice! Still, I would love to be able to become more proficient with SC so as to tailor the environment to my needs.”

With responses like these, I find that the project has succeeded in fulfilling the original aims.

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**Production of a Spatial
Audio Narrative****Introduction**

Craving is a site specific spatial sound composition set up by the two artists in the public space of Vienna's Donaustadt district. It unfolds while the audience individually wanders the high-rise area. Wearing headphones and mobile computing devices they physically navigate the piece. Their path is in no way – auditory or visually – predetermined, thereby allowing the audience to let themselves be guided by intuition and the aspects of the place.

Text

The text used draws on *Crave*, a play by British dramatist Sarah Kane. In it, four sparsely drawn characters weave a tapestry made up of quotations and fragments, the cloth of which are their individual traumas, loves, grieves and resignations. Plot and signs indicating temporal developments are reduced to a minimum. It is in repetition and the final defeat of communication of internal landscapes that we come full circle to the urban desert we found in between the towers of Donaustadt. Kane's text, which is filled with elements of subjective meditations on urban surroundings, but devoid of stage directions has been rearranged and expanded using pieces of everyday conversations to work with individual clusters according to the demands of certain places.

Method

The selection and spatio-temporal distribution of sound elements require a detailed study of text and conditions of the space such as architecture, flow of pedestrian movements and the rhythms of everyday life. The technology framing the production plays another very important role.

As environmental influences such as weather or social interaction surrounding the participants or their personal movement patterns cannot be



Fig. 1: Photo: Bernhard Garnicnig

foreseen, the sound design is not geared towards constructing a linear narrative. It aims, rather, to create individual, but loosely-connected scenes. To achieve this, acoustic elements are placed on street corners, on wide open spaces or in lively passageways as they relate to a sensation and meaning created by their architecture or the human beings inhabiting it. For this, the artists have developed a software, which enables a composition of temporally and spatially dynamic acoustic scenes.

Sound fragments such as spoken language or music are grouped together, following an internal temporal logic. These groups are distributed all over the area and linked through the recipient's perception as he moves through the space.

Applying their other senses and their feeling for the specific place the participants then put the perceived sensations into a larger context. This ability to freely associate intentional design elements through reflection accepts the spectator in the temporal and spatial complexity of his cognition.

Technology

The participant is equipped with a wearable computer and headphones. Custom software determines his position via GPS and tracks his head- and body movements through a magnetometer. Based on the sensor readings the computer renders the audio composition in real-time. This technology allows us to virtually place snippets of recorded speech and music at specific Latitude/Longitude coordinates, so that the participant is able to walk through them as if the voices in the recordings were actually there.

Site

Craving was envisioned for production in Vienna DC, a modern complex of commercial and residential buildings in the city's Donaustadt district.

This most preeminent area is defined by a branch of the river Danube in the south and the United Nations building in the north. Vienna DC was conceived entirely on the drawing board after plans for a World Fair in this location had been vetoed in a referendum in that same year of 1991. Nevertheless, ten years after its opening, the area is still *urbanity in progress*, as various vacant lots create a layered surface, whose heaps of dirt contrast with the spotless facades otherwise dominating the view. Vienna DC houses numerous multinational corporations and information technology firms in office skyscrapers, but there are also vivid residential zones in between. One can literally walk around a corner to see the number of suits diminished and people leading their lives in a slower and more informal way. There is a bizarre city within, whose 4.000 inhabitants have adopted to the given system of open spaces and the spatial logic of the complex. Unique architectural features strongly influence the way in which the space is perceived: a wide flight of stairs leading up to nothing, surveillance cameras placed at eye level, deserted children's playgrounds, a vast empty space whose floor is covered in glaring white paint. This microcosm allows the artists to use the space's emotional tectonics and possible associations while breaking with the normal patterns of movement, perception and interaction with the environment and other people.

OTTO

Musical Instrument for Realtime
Manual Beat Slicing

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About the project

OTTO is an electronic musical instrument for realtime manual beat slicing. The beat slicing is a well developed technique used mostly in electronic music, by means of what short rhythmical audio samples, of a few seconds in length, are cut into pieces to separate the main drum hits. These slices are then re-arranged in time, stretched, reversed, pitched up or down and so on, in order to create a completely new rhythmical section which could ideally last forever with continuous changes. The purpose of this project was to design specific controls for a technique that doesn't have a specific hardware yet. The device provides a tangible user interface designed with the aim of giving the user the feeling of having the sample in his hands. The performer can manipulate an audio sample in real time through the use of a restricted number of physical controls and clear visual feedbacks.

The philosophy

OTTO was designed after many comparisons between electronic musical instruments and conventional ones. Usually the second category is more engaging and requires an high and continuous control from the musician. This is due to the kind of interaction but also to the strong connection between sound, instrument and human being. Let's take a drum set for example: if you hit a snare you'll feel that the instrument is making the sound not just thanks to your ears but because you feel also the vibrations of it in your arm. This doesn't happen with a drum machine for instance, where the connection between sound and instrument is very weak. OTTO was designed thinking about other ways to improve this link between human action and sound, working on feedbacks and visual elements, but moreover designing specific interactions and their relative controls. The result is an instrument which

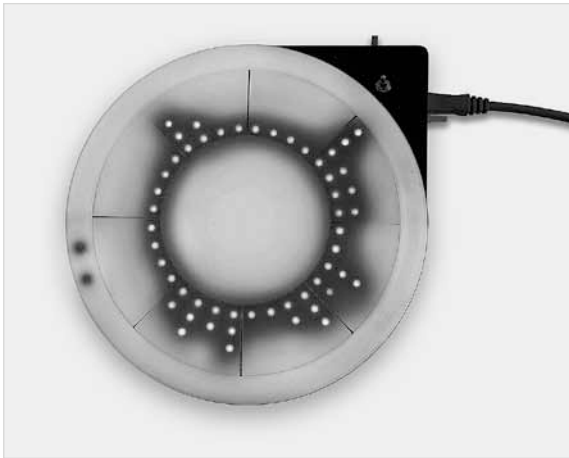


Fig. 1: OTTO playing a sample Photo: Luca De Rosso

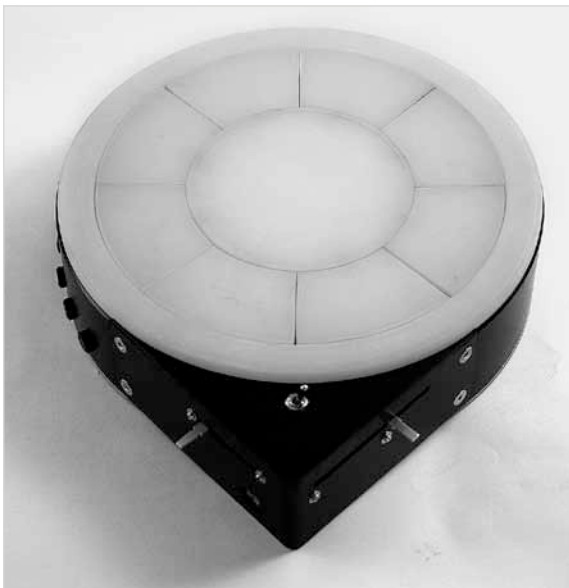


Fig. 2: Front view Photo: Luca De Rosso

doesn't necessarily make beat slicing easier – in fact there are computer softwares with algorithms which make very powerful effects just by moving few parameters with a mouse – but instead it gives to the performer more engagement and also more fun. This is also part of the reason why it's a musical instrument and not just a controller. As every musical instrument OTTO has its own learning curve, so to take the first steps with it is easy but if you want to push the instrument to the top of its possibilities you have to push yourself as well.

Feedbacks

The controls work definitely better if they give a feedback in return. The main goal of this project was to show to the performer what's happening to the audio sample while you are applying effects on it. In computer music, the audio samples are generally represented with a detailed view of the waveform itself or with little colored blocks and many other shapes. Since to slice the sample, the instrument needs to be controlled very fast, the performer needs to understand quickly where and how to play a specific part. The sample's visualization on top of OTTO has in fact been designed to provide just the information needed for that and nothing else. It's still the wave form, but represented in an extreme schematic way, so the performer can understand at first sight which parts are more full of sounds and which are not. However, this visualization does not have the purpose of making understandable how a slice will sound before playing it but after watching it playing once, you'll never miss a beat.

The prototype

Making a working prototype was fundamental to test if all the theories and the designed features of the instruments worked. Moreover, it was very helpful to understand where and how to fix bugs and usability issues. Anyhow, since it was impossible to me to prototype the whole instrument, the final prototype shows more or less half of OTTO's capabilities; but it was enough to test the design and achieved goals. Besides that, the instrument is capable of giving a lot of fun even if it is not in its final shape. The hardware is powered by an Arduino board, which controls all the input and the visual outputs. The board is then coded with a protocol to communicate with a Max/MSP patch which handles the audio effects and analyzes the waveform to visualize the sample. Concerning this point, a few words are due, to say thanks to the Max/MSP, and the Arduino communities; without their help I would have never had the chance to show a physical and working prototype of OTTO.

References

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Olivier Pasquet (fr)

Sound Artist

The Doomsday of Music

Many people worked on synesthesia with audio and video. The age of information moves to an age of physical information using conceptual and intelligent softwares, robotics and real digital fabrication.

This last year, I have been interested in materializing music. Writing a traditional score is most of the time not adequate because time and its perception are not behaving the same way as in instrumental music. Frontiers between creative process and performance process merged thanks to non linearity of time with algorithmic arts. Also, a generated piece does not have one single timeline. It is something much more complex that could only be described and written linearly until the combinatory pieces of Stockhausen in the 60's. Thus, representation and score combine in many cases and the need to write or describe music is very different from the one for instrumentalists.

The obvious way to do so is the use of dimensions, space or geometry. Many classical music composers use geometry. In our case since the only material constraint is perception rather playability, it is possible to extend this geometric abstraction in space; the real world.

I use geometric and architectural rules to represent and generate musical structures with the same approach as Yannis Xenakis used to do in the 70's. Geometry is a powerful tool mostly used for information theory and representation. It is also a great inspirational source for the genesis of musical forms.

My presentation will explain what I mean with "parametric composition" using a concrete example: a new piece called Kaspar.

De Saussure's structural linguistics is another story but architectural structuralism thru computational design is not an end. Scales and dimensions take an important role by adding other organized and self-organized elements to any kind of so-called structure.

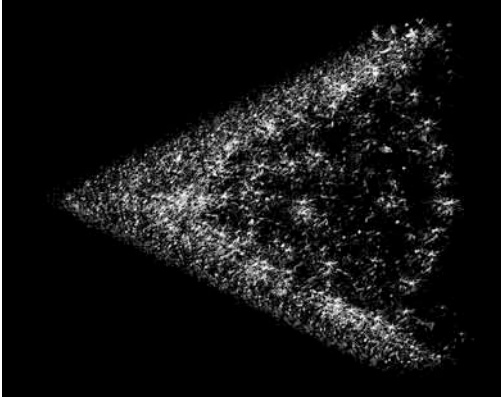


Photo: Olivier Pasquet

I will illustrate this idea with another installation project of materialized music I am willing to create in the near future: The doomsday of music.

Kaspar is a play from Peter Handke written in 1967. Peter Handke's Sprechstücke, through focusing on the performance of language, partake in the postmodern critique of representation. As a species of non-matrixed theater, theater which avoids the strong traditional fictional matrices of time, place, character, situation, and action, the "speech-plays" raise interesting issues pertaining to language, representation, presence, and performance.

The abstraction level of Kaspar is very rhythmical and very close to musical multilevel cannons and structures. This piece is not really a piece where time is directly involved. Reactivity or interactivity are useless because of the way we are forced to look at it and the way it has been generated. The time component is part of the visual and of its interpretation.

The doomsday of music is a small construction the design of which follows the same structural rules as the music and spacial movements played inside. It is a 5 meters wide digital fabrication (3D printing) made of fake or real spider web as a dedication to Louise Bourgeois. Since parametric composition techniques are used the real structure and its moving light reflexions and sound movements are together. A multichannel audio system diffuses 3D generated music made from the same emergence as spider multi-agents. As usual the challenge is to make people understand the relation between what they see and what they hear.

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The attract-o-tone: a Performance-Oriented Musical Interface

We all know the sound of a guitar, a piano or a trumpet. And with those rather traditional Instruments, the observer easily understands how sounds occur, which are created by. Yet, contrary to a drumkit or a theremin, most of the motion happens hidden in detail. Only the audience physically close to the musician gets to associate the movements of the hands and fingers with the produced notes. Who isn't near, won't be able to do that, simply because of not seeing what the musician is doing. And the more senses are involved in perceiving a situation, the more intensely it will be experienced. Therefore we intended to create an interface that demands exuberant gestures of the musician.

The attract-o-tone is a result of diverse approaches and phenomena, which formed its momentary state through an experimental development. The first thing was playing around with electronic waste. Through tinkering and circuit bending with leftovers from old guitars and RC-vehicles, we discovered the possibility to create very unusual soundscapes. The second step was to take a fixed idea and, through the process of rapid prototyping, rapidly make a prototype. We focused on developing an interface, that would possibly not depend on external power supply or any attached cables. Furthermore we investigated the qualities which the design of an instrument must achieve, which again led to the actual version of the attract-o-tone.

One of the attract-o-tone elements always is the actuator to the other element, which senses its behaviour and forwards the information in order to generate a responding sound. This duality and conversational character determines the shape of the interface. The relation of the objects to each other creates the sound. The relation(ship) between two persons also creates an atmosphere, that lays down the colour of the situations sound. If the persons feel attracted to each other, a certain tension fills the air. If one meets someone one finds repellent, on the other hand, the air can get thick. Those

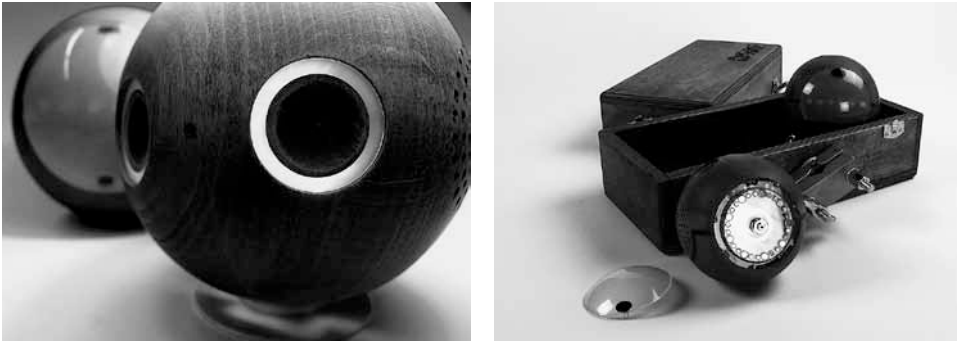


Fig. 1 +2: The attract-o-tone

analogies are fundamental to the duality of the attract-o-tone. The playful moment of the in-between is most important.

In order to make the handling of the attract-o-tone intuitive, we've given it a visual reference to the sound it brings out. The semitransparent vizor and jointings are lit by LEDs from inside, which corresponds to the actions and reactions.

Designing the spheres, we strongly emphasized that each one gets a unique look, that yet visually highlights the togetherness of them. Furthermore, the design had to be reduced to the functional aspects and refer to the way the interface shall be handled. The playability of analog instruments is mostly reduced to pushing buttons, keys or pulling strings. And in most instruments, this is reflected in the design of their bodies, which mainly consist of simple geometrical shapes. Therefore we stayed with a sphere as the body to our instrument. The sphere as a basic shape suits both left- and right-handed persons. And because analog resonators, or bodies of instruments, are in many cases made of wood because of its fine resonating and haptic characteristics (although in our case we didn't need the resonating qualities), we decided to craft the attract-o-tone from two solid wooden balls (beech in the first design prototype). Additional to the haptic value, the solid wood has a great visual quality. The vizor gives a direction, as well as it is the access for maintenance.

The stage setting of electronic musicians is dominated by tables for equipment like mixers, controllers, sequencers and so on, while with more analog generated music, tripods, instruments and their racks dictate the scene. The case of the attract-o-tone is designed, for it to serve as a station to fit between the table-equipment, while also charging the batteries of the interface, as well as it can easily be mounted on a tripod with any standard clamp.

We are proud that the attract-o-tone already made 3rd place in the engineering category at the *diy-festival for mechatronic art in Zürich 2008 and 1st place for best student project at the ICMI-workshop on tangible music interfaces in Berlin, 2009.