Design Considerations in Computer Music Environments

SIMON FRANK

KTH Computer Science
and Communication

Bachelor of Science Thesis
Stockholm, Sweden 2010

Design Considerations in Computer Music Environments

S I M O N F R A N K

Bachelor's Thesis in Media Technology (15 ECTS credits)
at the Degree Programme in Media Technology
Royal Institute of Technology year 2010
Supervisor at CSC was Christer Lie
Examiner was Johan Stenberg

URL: www.csc.kth.se/utbildning/kandidatexjobb/medieteknik/2010/frank_simon_K10021.pdf

Royal Institute of Technology
School of Computer Science and Communication

KTH CSC
SE-100 44 Stockholm, Sweden

URL: www.csc.kth.se

Abstract

In a creative computer music environment, there are several aspects that makes a traditional view of usability insufficient. For example, the effectiveness of the interface is of less importance when the goal of interaction is not fully predefined and when the interaction is voluntary.
The basis for this study are numerous interviews with people active in computer music. Based on the results of these a following discussion aims to clarify what these aspects can imply, what should be taken into account when designing user interfaces for this environment and how different views on interaction can be applied. Some possible design solutions are also presented.

Sammanfattning

I en kreativ datormusikmiljö finns det flera aspekter som gör att en traditionell syn på användbarhet inte är tillräcklig. Till exempel så har användargränssnittets effektivitet en annan betydelse när målet för interaktionen inte är fullständigt definierat I förväg och interaktionen är frivillig.
Underlaget för denna undersökning är ett flertal intervjuer med personer aktiva inom datormusik. Utifrån dessa diskuteras i uppsatsen vad dessa aspekter innebär, vad som bör tas i beaktning vid utveckling av användargränssnitt och hur olika syner på interaktion kan tillämpas på denna miljö. Det presenteras även några möjliga designlösningar.

Table of content

1 Introduction

Computer-music production is in many ways a creative process in the sense that the outcome of the process is not clearly predefined (according to New Oxford American dictionary creativity create something new). In this kind of processes there is additional considerations, not conventionally covered in the discourse of usability.

1.1 Background

In the early days of music recording, the process was usually divided between the performing musician and the recording engineer, whose prime task was to make the recording sound as near the reality as possible [1]. There are several cases that indicate that these roles where not as clearly separated, but it serves to illustrate my point. With the entrence of popular music in the 1950-60's the focus on recreating the original performance on the recorded media was shifted towards a more creative recording procedure where the studio and it's technology was considered as a additional compositional tool[2]. This development has continued actuated by several elements. One is that the record is one of few things that can be considered as it own marketing material and more spectacular sounds draws more attention from the consumer. Another is that the technology have allowed it. With the advancement of more powerful personal computers in the late 1990's it was possible to use a single home computer for both recording, sound synthesis, sequencing and sampling and this with the same sound quality as on a compact disc. These new circumstances further merged the role of the producer and the musician by combining both types of work in to the same machine. This was especially notably amongst semi-professional and hobby musicians who no longer could motivate the cost of hiring a recording studio when they could achieve a more then satisfying result at home[3].
The combined roll is perhaps as most present in the computer-music[4] (CM) environment, where the commonly used tools provides an interaction that in many ways reminds of the one of a traditional sound engineering but in the same time, is a creative process in the same sense as 'ordinary' musician, playing acoustic instruments.

1.2 Purpose

In this exploratory study I will examine what kind of elements that might contribute to a high usability in the environment of creative computer-music production.
What underlying processes in this interaction to consider while designing interfaces for this environment and how different views on interaction (in the field off HCI) could be applicable.
The attending question is on what grounds a system or device is considered useful, if these grounds include other factors then the sonic abilities of the system and if so, what possible design solution there might be.

1 Nicolas Collins - 'Ubiquitous Electronics - Technology and Live Performance 1966-1996' 1998

2 Nicolas Collins - 'Ubiquitous Electronics - Technology and Live Performance 1966-1996' 1998

3 Bennet A. Peterson R, 2004

4 Evaluation of Input Devices for Musical Expression: Borrowing Tools from HCI

Author(s): Marcelo Mortensen Wanderley and Nicola Orio

Source: Computer Music Journal, Vol. 26, No. 3, New Performance Interfaces (Autumn, 2002), pages. 62-76

1.3 Definitions

1.3.1 The CM user

The term computer-music is somewhat obsolete and futile as most modern musician employ computers in their work in some way, as an aid for classical composition, recording of acoustic instrument, sample processing or as a source of computer-generated sounds. Most musicians combine several of these which makes it hard to delimitate what should and what should not be considered as computer-music. The term is, however, commonly used and widely established in both academic and non-academic contexts (eg. Computer-Music Journal, MIT Press and more consumer oriented Computer-Music Magazine, Future Publishing Limited) that I'm not going to try to form any new name or expression. In this thesis the term computer-music (CM) producer will refer to someone who use the computer as an expressive tool for music production in a wider extent than raw editing of self recorded material (ie. not solely as a dedicated recording device) and creates a complete song within this environment (ie. not only for sketches). The typical interaction is not time critical in the same sense as a live improvisation performance, where a delay between idea (or decision) and realization can have a negative effect on the result. The typical process/work is in a early stage production (ie. not mastering or final mixing) where the presence of creative work is more apparent and where the rise off new ideas can be considered as more desirable. Even though most people probably would refer to this kind of person as computer-musician, I'll use the phrase CM producer as I believe it better reflects the kind of process and environment that I'm referring to. "Musician" also gives the impression that the user have received classical musical training or have similar understandings of music theory, something that is more rare then common[5].

1.3.2 The CM Environment

The CM environment is the extended system in which the user interacts. It can be problematic to further define it, as it commonly consist of several devices or tools in a combination that suits the user and therefor vary a lot These devices can be both GUI-software (e.g. a program or a plugin to another program, or a part of a program) or physical hardware (e.g. controller, synthesizer, etc). In the text "Improvisation machine", J. Bowers describes this kind of (or similar) environment as a "assembly"[6](though in the context of live performance), a term that perhaps better emphasize that these tools doesn't need to be a part of the users system all the time. He also argues that a single device should be seen in the context of it's assembly. An argumentation I agree with, but as "assembly" is a bit narrower I'll use the term environment.

1.4 Terminology

Mapping - is the scheme of relations between the technical parameters (in a computer algorithm or i in a electronic circuit) and the parameters that are presented for the user to interact with in the form of knobs, buttons or other sensors. The most basic mapping is to set max/min values and scale for a (user)parameter so that only the vital or interesting intervals are presented. For example a single continuos note and its pitch controlled by a knob. Then the max and min values might be set to 20 kHz and 20 Hz respectively, as this is the audible interval. A logarithmic scale might be chosen, as this better corresponds to how the increment or decrease of pitch is perceived while turning the knob. The more complex, and perhaps more interesting part of mapping is how parameters in the interface

5 T. Andersson 2010

6 Improvising Machines -Ethnographically Informed Design for Improvised Electro-Acoustic Music by John Bowers 2002 obtained from http://www.ariada.uea.ac.uk/ariadatexts/ariada4/html/ read 2010-03-19

relates to several sonic, and how different parameters can be mapped to each other in non linear ways to create a device with less ‘uninteresting spots’.

Controller - sometimes refer to as midi-controller or control surface. If not explicitly stated this would imply a physical interface with knobs and buttons (even though some controllers utilize more exotic sensors) in some arrangement and that could be assigned to control parameters in another system, generally a computer. The most common controllers only provide unidirectional feedback. That is, there is no certainty that the state of a physical knob or button correspond to the actual state of the assigned parameter.

Project - in most cases this refer to a musical project which can be settings or presets within a device, recorded files, and several versions saved at different dates.

Sampler - by tradition a physical machine with the possibility to process short recorded sound, refereed to as a sample. by pitching, looping, reverse, filter, etc. Sometimes this machine also incorporates a sequencer to play samples in desired order, but is still refereed to ass as sampler.

Plugin - plugins to software systems, often in the form of VST (Virtual Studio Technology) and could be a instrument (eg. synthesizer or sampler) or an effect (eg. filter, reverb equalizer).

Sequencer - A device which can be programed to play notes in desired order, the process of program this machine is commonly named sequencing. Some sequencers features extentional aid, like swing (small time offsets which makes the sequence sound more ‘human’, or give it a different ‘feeling’)

Mastering - Often the last changes made to a song where the dynamic levels and frequency spectrum is fine adjusted.

GUI - Graphical User Interface, the one presented on a computer screen.

2 Understanding the CM environment

2.1 Within the notes

The CM interaction could be described with a conductor directing a orchestra. A mehafor that illustrate that there's no direct realationship between the user and the intrument as with a muscian playing an traditional aucostic instrument. However, most CM related devices provide a very detailed control over the sound that exiedes the control of any conductor or classic intrumentailst.
Sergi Jordà descibes this detailed controll as 'Within the notes'[7], that not only is it possible to controll the timing, length and velocity with exact precition, but also the sound within each note can be controlled with whatever parameters that the current device provides (which usualy is many). This provide many musical possibillities, but in the same time a endless amount of options for the CM producer to consider.

7 Sergi Jordà, New Musical Interfaces and New Music-making Paradigms - proceeding NIME 2001

2.2 Sonic perception

It might be tempting to make analogies or comparisons with other creative environments that are more visual orientated. This might not be successful in some , particularly because of how the audible and visual senses differ. In comparison the ear is a more subjective way of obtaining information then what wee can see. This is reflected in the language. A picture could be described in terms of objects, shapes and colors, but if if try to adopt the same objective adjectives on sounds it appears that the language are missing. For example violin-like sound would refer to some harsh high pitch sound, but it still isn't as distinct as a "three shaped".

When trying to describe sound with words, there are few analogies from our everyday life to take use of. And if they are, they can still be interpreted very different between individuals, depending on their previous experiences.
What I'm trying to get at is that there's no obvious symbols or visual language to communicate sound with, it's possible on a technicaly detailed level. Controlling the frequency spectrum for example.

Different sounds can mask each other. That is, a sound that is clearly perceived in quiet can be hard to distinguish if other similar sounds are present at the sam time has the same or higher intensity[8]. This is called audio masking or sound masking and can result in situations where it's hard to relate a certain parameter to certain sound and vise versa.

2.3 Visual influence on sonic perception

In CM there's another aspect of perception that are rarely discussed from a design perspective, how the visual senses have a somewhat more primary role then the sonic on our perception.
Two statements that illustrate this quite well are from a workshop held under the AES[9]:

> "Anyone who records or mixing professionally has done this at least ones in their career; They tweak [adjusting a equalizer, i.e. EQ] a snare or a vocal track to perfection, only to discover that the EQ was bypassed the whole time, or you where tweaking a different track... If you've been mixing for a few years and you haven't done that, then you're lying." - Ethan Winer

> "You'll have to do a blind test because if you know what two things are, [in terms of what kind of technology is affecting the sound] your brain is going to use that information, I don't care of how smart you are, how trained you are, who you are. There hasn't been an example yet of someone who can avoid it." - James Johnston

Even tough these statements primarily are personal opinions, they demonstrate that visual impressions can have a large impact on what we believe we are hearing, and that it's something that's present even in a professional environment.
It's also worth remembering that the primary feedback, in most systems, is visual. Parameters are presented on a screen and demands some observation while adjustments is made. In physical interaction this isn't as present, but visual feedback is common even with devices where the input is physical.

---

8 S. Ternström

9Audio Engineering Society (AES) Convention in New York City, October 2009, Audio Myths Workshop.

Obtained 2010-01-19 from http://www.youtube.com/watch?v=BYTIN6wjcvQ (ca 1h video that summarize the 6h work-shop)

3 Previous work and different views on interaction

3.1 Measurable interaction

As the focus off this essay is the on elements *not* covered with these methods I will not discuss them any further. I also believe most readers are familiar with them and a explanatory walk-through seems redundant. The methods implied is for example task-completion-ratio, effectiveness, control over the system and state of the system feedback. For a more comprehensive explanation of what these methods or views imply I reefer to Preece et al, 2002[10].

3.2 Interaction as intended by the designer

In 'Designing for fun: User-testing case studies'[11] Pagulayan et al discuss how HCI methods could be used in the developing process of games (in this case Halo for Xbox) to increase the game experience. They write:

> "In this case study, the perspective of usability test goals has been shifted away from the end user, and toward the designer. In the Halo example, the goal was to ensure that the user experience matched designer intention. These types of situations often require less structure than more common usability methods. Once we are confident that users are playing the game in the way that designers intended, we can begin to get feedback about subjective preferences on the game's design."

If it comes into existence that users apply certain methods to solve a problem within the game which makes the game less interesting, the redesign should aim to encourage (preferably without constraining) the user to interact in a way that match the designers vision of what behavior that yields the most favorable experience. This as opposed to a more traditional view, where the design iterations aim to a adapt to the behavior of the user and make changes in the interface that better fit the users way to interact. A premise is that the designers vision really is the most favorable experience, but as the authors also points out, this is something that is better evaluated once the vision or concept is realized (i.e. the users interacts 'correctly' or as intended by the designer).

3.3 Product character

In 'The Thing and I'[12] M. Hassenzahl discuss the more subjective aspects in the relationship between users and products (from a user experience point of view) and how this relationship affects the interaction (a 'product' in this case would refer to a 'device' or 'system' in the earlier established CM terminology). He uses the term 'character' to describe this relationship and defines it as:

> "A character is a high-level description. It summarizes a product's attributes, e.g., novel, interesting, useful, predictable. The character's function is to reduce cognitive complexity [i.e. perceived as lucid and logic] and to trigger particular strategies for handling the product. When individuals come in contact with a product, a process is triggered. First, people perceive the

10 Preece Sharp – Interaction Design 2002

11 Randy J. Pagulayan, Keith R. Steurby, Bill Fulton and Ramon L. Romero - 'Designing for fun: User-testing case studies' from 'Funology- From usability to enjoyment' edit by Mark and A. Blythe.

12 Marc Hassenzahl - The Thing and I: Understanding the Relationship Between User and Product

ISSN 1571-5035. Volume 3. Funology 2005 edit by Mark A. Blythe, Kees Overbeeke, Andrew F. Monk and Peter C. Wright. Pages 31-42. ISBN 978-1-4020-2966-0 (Print) 978-1-4020-2967-7 (Online). Publisher: Springer Netherlands

product's features. Based on this, each individual constructs a personal version of the product character"

This character could be expressed as the one that corresponds to the designers vision of how a product (ie. device) should be perceived and interacted with. Hassenzahl call this the 'intended product character' in contradiction to a 'apparent product character' that is the one really perceived by the user when utilizing the product. The apparent character is not general for a particular device, rather something that is an outcome off personal premisses and subjective perception (Hassenzahl writes about this in terms of "pragmatic and hedonic attributes"). Also the context in which the interaction with the product takes place or where the product present itself have an affect on the apparent character. That is, a device or product could be experienced differently in different context. An experience that, consciously or subconsciously, is memorized, and then is reflected in the apparent character, also in other contexts. For example a bottle of cooled water of brand x, first experienced (i.e. consumed) under a hot summer day can effect the way the same x brand bottle is perceived five months later in a supermarket. If to many, other memorable experiences have occurred between the two occasions the association between the first memories and brand x can get somewhat diffused, and another character is associated to the brand x bottle. This example also illustrates that it's not only first impressions that affect apparent character, it can evolve, change and develop over time in the use of the product (which Hassenzahl also points out) or as the users premisses changes. Premisses that can be an outcome of the use of other similar products that provides other, more (or less) appreciated features.

Hassenzahl continues that all these attributes reflected in the apparent character have both "... emotional consequences (e.g., pleasure, satisfaction) and behavioral consequences (e.g., increased time spend with the product)." and draws the conclusion that "A suitable design process must assure that an appropriate product character is selected and that this character is properly communicated to the user."

Hassenzahl account some suggestion of how to communicate this (some that I consider as less relevant for the CM environment and haven't included).
"Stimulation ... [a device that] ... provide new impressions, opportunities, and insights". Even though a features isn't utilized, it can still communicate that the device provides a possibility to explore it. This exploration can then infuse the feeling of personal development.
"Evocation ... [a device that] ... represents past events, relationships or thoughts that are important to the individual (Prentice, 1987) ... A more technology related example might be ... vintage computer games. ... Their value comes from triggering memories of the good old days, when these games were exciting and kept people captive for hours."

An example that more closely would relate to CM is the common use of vintage synthesizers as a metaphor in the GUI of their software counterparts. These also includes so called clones, that is a emulation of the whole system, but this is also present in GUI's that doesn't claim any relation to existing vintage gear (some of IK Multimedia T-RackS suit or PSP Vintage Warmer for example)

3.4 Expressive interaction

NIME (New Interfaces for Musical Expression) is a conference held on a yearly basis that aims "... to share their knowledge and late-breaking work on new musical interface design"[13] but also on the evaluation of new interfaces. Even though most of the related texts (in the form of pre proceedings) have a focus towards "expressive musical interfaces"[14] [15], "expressive instruments"[16], "interactive music systems"[17] or "live performances"[18] [19] that commonly manifest itself in the design of interfaces that have more similarities to traditional acoustic instrument but utilizes digital sensors.

In the pre proceedings to the first NIME, 2001[20], N. Orio et all writes that "Live performance of computer music can be seen as a highly specialized field of HCI ...". They then discuss how HCI methodologies could be adopted to this field and highlight some interesting considerations that also illustrate how CM differ from other fields of interaction:

> "Learnability - It is essential to take into account the time needed to learn how to control a performance with a certain controller. It is known that a musician needs more than ten years to master a musical instrument [[21]] a time far too long for any kind of measurement."

Here 'performance' would better be described as sketching to fit the situation of CM interaction.

> "Explorability - A feature of interest is the exploration of the capabilities of the controller, [ie device] that is, the number of different gestures and gesture nuances that can be applied. "

What possibilities of exploration does the device provide and to what level. They don't further in to this, more then state that, it's just a feature of interest.

In another proceeding to NIME[22], C. Dobrian and D. Koppelman examines some of "the characteristics of effective 'expressive' computer music instruments" and tries to somewhat clarify the term expression (a frequent term within their field, but rarely problematized) and what causes it. They state:

> "Simple one-to-one mapping of input control data to a particular sound parameter is essential in many cases in order for the performer to have precise control, but such control is not equal

13 Obtained 2010-04-15 from www.nime.org

14 Discourse analysis evaluation method for expressive musical interfaces by Dan Stowell, Mark D. Plumbley, Nick Br yan-Kinns. NIME pp 2008

15 Creating a Context for Musical Innovation: A NIME Curriculum by Gideon D'Arcangelo. NIME pp 2002

16 New Musical Interfaces and New Music-making Paradigms by Sergi Jordà. NIME pp 2001

17 Evaluating Interactive Music Systems: An HCI Approach by William Hsu and Marc Sosnick. NIME pp 2009

18 Creating a Context for Musical Innovation: A NIME Curriculum by Gideon D'Arcangelo. NIME pp 2002

19 Learning Advanced Skills on New Instruments by Sageev Oore NIME PP 2005

20 Input Devices for Musical Expression: Borrowing Tools from HCI by Nicola Orio, Norbert Schnell and Marcelo M. Wanderley. NIME 2001. Edited version of same text also in: Evaluation of Input Devices for Musical Expression: Borrowing Tools from HCI

Author(s): Marcelo Mortensen Wanderley and Nicola Orio

Source: Computer Music Journal, Vol. 26, No. 3, New Performance Interfaces (Autumn, 2002), pages. 62-76

21 Reference within quote: Lehmann, A.C. (1997) Efficiency of deliberate practice as a moderating variable in accounting for sub-expert performance. In Delige and Sloboda (eds.) Perception and Cognition of Music. Psychology Press.

22 The E in NIME: Musical Expression with New Computer Interfaces by Christopher Dobrian and Daniel Koppelman

Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06)

> to expression. [...] Expressive control relies on more sophisticated use of the control input information, such as through one-to-many mapping..."

As most of the papers in this area they discuss expressivity in relation to live performance, and what causes expressiveness in a live performance might differ from the one in CM. However, they are related, and might not easily be treated separately. Dobrian and D. Koppelman argues that:

> "In the case of 'programmable instruments' [eg. devices as in CM] and live control of compositional computer music algorithms, the distinction between compositional expression and performative expression may be blurred..."

They also point out that what is refer to as expressiveness in the interaction with traditional acoustic instruments is a result of, sometimes centuries, of exploration, both scientifically (i.g. how to make it sound good) and less methodical, creative (e.g. using string bow on guitars [x** better example?]) processes, and that it is somewhat naive to believe that the full potential of expressive utilization of an interface would manifest itself, only within months after the interface was 'invented'. It takes time, both for the 'instrumentalist' (or CM producer) to learn the interface, but also for the musical community to establish and share successful musical gestures or methods.

Cornelius Poepel also discuss expressivity and argues that:

> ''According to present evaluation methods of musical interfaces the potential for musical expressivity can hardly be evaluated because the question of which kind of musical expression the interface will be used for cannot be answered[[23]]"[24]

3.4.1 Modes of expressive interaction

B Bonger trying to characterize the interaction between a ''electronic system'' (=device, sensors) and the musician (ie CM Producer) [Physcal interfaces in the elec...] in to the following three states. The performer-system (e.g. a musician playing an instrument), system-audience (e.g. installation art), and performer-system-audience.

3.5 Unintended use

E. Stolterman argues that instead of see unintended use as a problem, designers should aim at encouraging this behvior[25]. Partly becouse an all to intended design can induce the feeling of being reduced to only a user or customer[26], but also becouse products might be more usable if they can be adopted to wider situations that meet unthought of needs of user.
He suggest some high-level principles for "intentionally design for creative unintended use", som of wich are already present in most CM environment by default, like providing oportunities to make changes to the sytem (ie. the use of devices). Among the other principles are:

---

23 Reference within quote: M. M. Wanderley and N. Orio. Evaluation of input devices

for musical expression; borrowing tools from HCI. Computer Music Journal, 26(3):62–76, 2002.

[NOTE: I don't find any direct relation between this article and the statement]

24 On Interface Expressivity: A Player-Based Study by Cornelius Poepel. Proceedings of the 2005 International Conference on New Interfaces for Musical Expression (NIME05) 2005

25 http://www.publicsphereproject.org/patterns/pattern.pl/public?pattern_id=15 obtained 2010-04-28

26 http://www.publicsphereproject.org/patterns/pattern.pl/public?pattern_id=15 obtained 2010-04-28 (Ciborra, 1992; Carroll & Rosson, 1987)

"...the system should [...] be 'forgiving', which means that it has some ability to accept creative use changes without demanding complete safety,"

"... the system should [...] be designed as an open system, i.e., make it possible for users to expand the scope and breadth of the system without demanding to much formality and admiinistartion.

As these where high-level principles, he dosent go in to more detail about how these principlces could be applisablee in a concrete situation.

3.6 Aesthetics

That the sheer appearance of a device could affect the way we interact might not be considered as obvious. Preece et al discuss this in terms off how "... the aesthetics of an interface can have a positive effect on people's perception of the system's usability (Tractinsky, 1997)'[27]. For example that a user can be more tolerant or forgiving to a interface that is perceived as visually pleasing.

The aesthetics is also discussed by J. Falk, but as something that "play an important role in creating engagement..."[28]. This kind of aesthetics doesn't have to be appealing or pleasing for the eye, rather a design that encourage the user to interact.

27 Preece, Sharp - Interaction design 2002, s143

28 Jennica Falk - Interfacing the narrative experience, funology chapter 11, s 255

4 Method

4.1 Interviews

As most CM producers incorporates more than just computers in their work[29] I believe its important to not only discuss the interaction with single devices as some important aspects might not be reveald that way.

The interview method where open, some predefined questions or topics where presented and there was a following discussion around those.
Every interview lasted for about one to three hours and seven people where interviewed. The sex distribution is clearly bias towards a male over representation (no females was interview), but this could be seen as a de facto representation of real circumstances. The interviews was held in different locations, over the phone and only a few in the users production environment.
Contextual interviews, as suggested by Beyer and Holtzblatt[30] might not have been succeful in a CM environment, for several reasons. The chances of observing a range of interaction processes or one that the user considers as successful are dim, as the creative process can be time consuming. The effect that the interviewer have on the interaction might also be more substantially under a creative process and as the interviewer had a knowledge of all devices and system concerned, a demonstration wasn't necessary. Because of this and due to the limited time frame off this essay a prioritization was made over a larger quantity in interviewees before a few thorough contextual interviews or etnhograpic studies.

5 Interview result

The results of the interviews are presented under topics that, either was a topic presented by the interviewer to discuss or aroused from these discussions. The number off topics could probably be heavily extended if more interviews was made.

Besides a wide range of physical and software devices, the persons interviewed utilized the following softwares as their main system: Ableton Live, Apple Logic Studio, Renoise, Propellerhead Reason and Fruity Loops (FL Studio). Which could be seen as a good representation in relation to the intended target group. The interviewees had at least four years of experience in CM production and none had any notably income from their musical activity.

5.1 Working methods

On the question ‘how do you begin a new project(ie. song, sketch, track)’ and how the end result would be.
A common approach seems to be by starting with a single element, a simple idea off something and build a song around it. It could be to imitate a element from someones else song and put it in a new context, or a particular sound (eg. sample or a synth-patch).
These initial ideas seem to have a function more as a starting point then a goal for the interaction itself as none off the persons asked thought there was any similarity between the original idea and the

29 T. Andersson 2010

30 Hugh R. Beyer , Karen Holtzblatt - 'Apprenticing With the Customer' COMMUNICATIONSOF THE ACM,May 1995/Vol. 38, No. 5

end result (even those that have evolved rather strict routines for how they work claim this). The original idea was either dropped or transformed to something else under the process. It was also common that other ideas appeared under the process, ideas that didn't fit the current project at all. This often lead to a total remake of the current project or that the new ideas was saved as a separate project to be worked on later.
It also occurred that the initial ideas was realised under a short intentisive process, but this was more infrequent. It was never clearified if these ideas had any substantional deffernces then the ones that wasnt realised or transformed.

One interviewee, who primarily used a EMU SP 1200 (a hardware sampler) at the time of the interviewm had divided the process into a initial creative work and less creative work. He proclaim: "I do all the creative work I do in a limited environment [SP1200]. The rest, dead-work [not creative work], like arrangement, which I see as the same as mixing or mastering, I do in Logic [a computer software]. Or arrangement is maybe a bit creative, but not to the same extent."
Arrangement in this context would be to create a complete song with variations out of shorter loops by partly mute some sounds or process them in other ways to momentary alter the sound scape. Another interviewee makes a similar division of work, but within the software Ableton Live which features two different modes. A "arrangement view"(fig.1.2) which is similar to the one present in Logic(fig.2), and a "session view" (fig.1.1), benamed as "jamming facility", where there's no global timeline and loops could be turned on and off. This mode or view is more suited for sketching and rapid trial and error as the state is continuos until the user change it, that is there's no continus timeline to relate to. Another interesting behavior is in the transition between these two modes. Same person explains that "once it starts to sound good, [in the session view] I usually stop and take a break ... mostly because I'm afraid to destroy it". Some users also save a copy off the project before switching between these modes (ie. entering arrangement view) for the same reason.
It might also be worth mentioning that a project can exists of over hundred parameters that affects the sound which rule out the possibility to revert to the initial state out of memory. The undo functionality isn't suitable in this situation as its very likely that several changes has been made. Changes that either isn't related to the initial state (global settings for example) or changes the user simply don't want to get rid off.

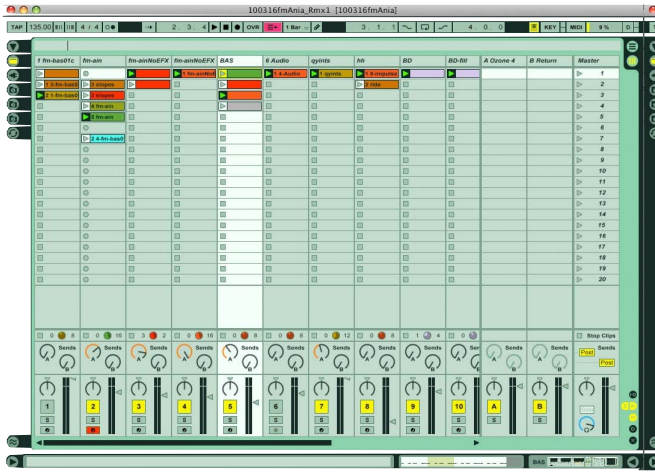

fig1.1, Ableton Live Session view.

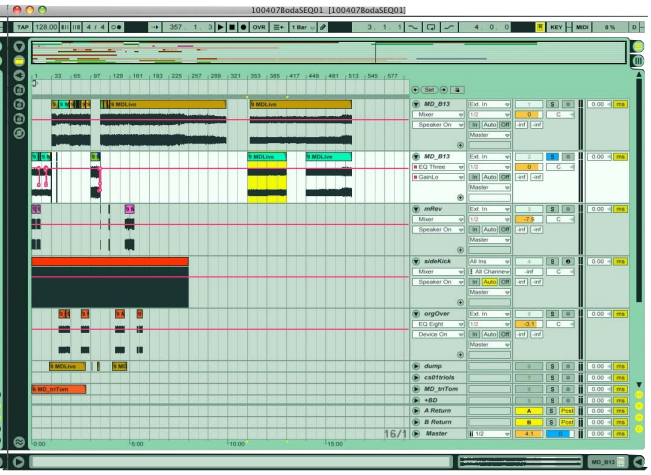

fig.1.2 Ableton Live Arrangement view

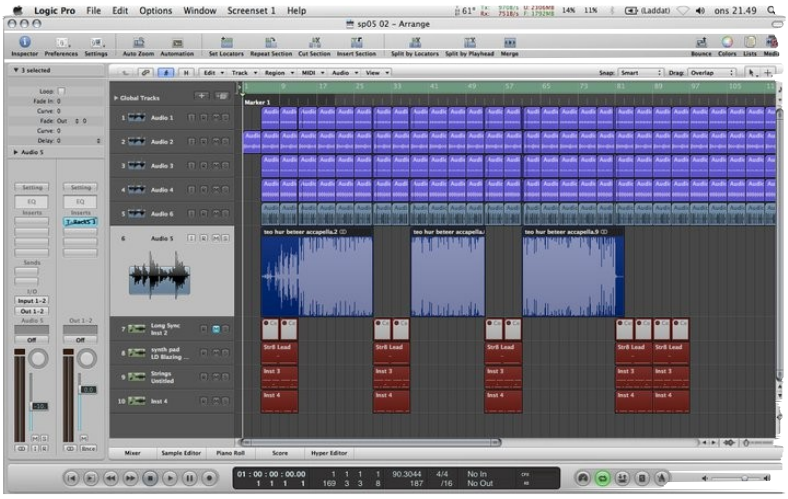

fig.2 Logic Arrangement view

5.2 Cheating

Something that is a somewhat underlying attitude in CM related communities (or in this case better described as; amongst creators of electronic music), is the idea of cheating in the process of making music. This is not not always clearly stated as precisely cheating, more discussed in terms of 'genuine' or 'authentic' methods. The actual outcome of a cheating, in terms of musical quality doesn't seem have any deeper importance in this discourse. For example one interviewee tells about some comments he received after uploading a song on a forum that was CM related. "... one of those who commented felt that he should "remove those original clap sounds" on the grounds that they were not original, [i.e. unprocessed] not that they sounded bad, didn't fit, etc".
It seems like this way of thinking act on a more personal level, (other producers are for example rarely blamed for cheating) some tools or methods aren't employed as they are considered as cheating in some way. This could be devices that simply make a lot of work for you.
On the question how they felt about cheating, or if there was such a thing, one interviewee describes a plugin that, even though he believed it was "snobbishly" to call it cheating, wouldn't use these type of plugin as it would feel "... like hire one to do the job for you." and continues that "you have an idea about something, and there are several ways off doing it ... I think it is in precisely this choice of how you choose to do it, that you can create an identity as an electronic musicians." And that this opportunity would get lost if he utilized this kind of plugins. Something that might argue that the unwillingness off 'cheating' is driven by other causes then a fear of not being original but more due to a aspiration towards a result that reflects their personality (at least for this person). Another interviewee tells that "I don't believe 'cheating' is compatible with personality [in the music] but I can still sound good" which also support this.

Some of the users say that, even though they are familiar with this type off attitudes, they aren't affected by this "cheating mentality". Which indicate that this is something that vary a lot between individuals. However, one that didn't feel affected could agree that a knowledge of the process, for example that a musical piece was produced under certain conditions, with odd methods or a long time ago, could make musical material more interesting,which off course doesn't have to be a contradiction, but still indicate that the judgement of music material is not only based on sonically impression, but also on how it's made, if such information exists.

5.3 Opinions and views on varied devices

It can be somewhat hard to conclude to what degree a device or system is selected on the basis of how they sounds or how fun, productive the interface are. One user states that "There are always different results when working with controllers [control surface] or external drum machines, for example ... far more simplistic results". The same person also explains that he only uses these external devices when he has room for a more spacey setup and time deposed to use it for at least several hours. This might suggest that as the goal is loosely defined there can be several ways to achieve them, and that the choice of devices isn't necessarily based upon how they affect the result, it's just a *consequence* of using them.

One of the interviewees mention a good example, on the question of how long it takes to explore a device before finding what situations it makes most sense to use it (e.g. what states of the device would fit in certain contexts): " I don't mind using presets [predefined states for a device] as a lot of them sounds great... I primarily use FM-synths [a synth utilizing a certain synthesis technology that often is inconvenient to edit] for percussion, but there's not a single preset for this."

"... many tools[devices] within Logic are not fun as they have a million parameters ... it makes you scroll through presets [instead of exploring], because you don't feel like exploring something that is so impenetrable, there are simply too many ways to go. ... this is a problem inside Logic, but it actually reflects that ... the whole computer is a bit of a problem. Because it is full of possibilities... you can log in to facebook for example."

[Rebirth] "... it is too easy, the uphill struggle does not appear and you don't devote as much time to it, as it's not interesting in the long run."

In the long time it's seems that the usability of a device or system is judged out of the material (i.e. music) produced that incorporates this system or device and how well this material comport with the goal of the user in terms of musical style. For example, a user can be satisfied with a result that is direct outcome of a single device, but the same device could be rejected if the result, that also includes the result of other devices, isn't satisfying. This could also be reflected in some sales ad for electronic musical gear that sometimes state the contradiction; "it's a lovely device but it doesn't fit my needs/style/goals" as a reason for selling.

Said about a plugin that made the work for you [auto-glitch] " The dilemma of all electronic music is that someone has produced it [a device] ... and thought that it should be used in certain ways ... you are a slave to what somebody else already figured out what to do with it [the device]. ... to some extend you liberate yourself from this by using things in unintended ways. ... Perhaps this is why a lot of good things [music] is made with old gear, it's not about the warmth of the analog sound [something vintage gear commonly is praised for], but rather that you have a different relationship to them. A relationship that is not created by marketing material."
A basic concrete example of this is the grid (fixed beat positions for notes) which is frequent in almost all sequencers. It might not be perceived as negative constrained though.

Said about softwares he had tried but didn't bothered to explore and learn any further "It just doesn't happens with some applications [devices], some I simply just avoid ... it does not feel good ... it's like meeting a person, you receive a positive or negative energy from them ... some programs devour your creative energy and then I don't see any point to use them."

In the discussion about unintended results that arise from certain devices, one interviewee states that: “I like it in a way, when you do not have full control. It's quite inspiring for me when the machines color the sound ... what happened now, so why is every where, you will feel like using them more."

5.4 Aesthetics

"... If I only look at one music application on the computer, [without interacting], already there, I think the link between the visual picture, the graphics and the brain, which start to think creatively, is influenced of what is presented on the screen"

5.5 Motivation

There seems to be no consistently amongst the interviewees regarding motivations, perhaps it’s a futile question, as the answer may lay deep in the human nature. It could however still be interesting from a usability perspective.
Even if the outcome of their work wasn't consumed by a large audience, the CM related work was sometimes mentioned as something that gave an increased self-esteem or as one person put it “it’s addictive for the ego”.

An interesting note is that several of the persons asked, was dissatisfied with music they have made, even tracks that they recently finished.

6 Discussion

6.1 Different states of interaction

I believee the process in a CM environment could bedivided into two different kinds of interaction: Expressive exploring and idea realisation.
Expressive exploring could be described as making progress by unsystematic testing or a trial and error method. This could be a test of how tactics that have been successful before might fit in the current musical context or a exploration of different parameter or device combinations. The later can arise that some experiments are intended and some unintended as it can be hard to fully predict the relation between parameters and results, even if you are familiar with the device and related technology.

As the name suggest, idea realisation is when a concrete idea is present. Concrete in the way that it's an idea about a tactic within a system which the user is familiar with. This to distinguish from ideas that are more vaguely and based on how something should sound, without concerns of how to achieve it. These could in turn be divided in a creative and less creative state In a way that is more throughly described in the working methods chapter in the interview result.
Whatever what kind of interaction that is most common is likely to vary between individuals, however the interviews indicated that Idea realisation was less common. A process might also toggle between these states with irregular intervals.

One might argue that the CM interaction should be divided between the one focusing on melody (including rhythm) and the one focusing on sound as the perception of melodic content can be considered as different from the one concerning only sound. Even though this might be a good distinction, sequence (i.e. melody) and sound overlap each other in CM environments to a extent that it's hard to formulate such a distinction. For example a melody played really fast is no longer perceived as a melody, rather just a continuous sound.

6.2 Intended interaction

A element that games and CM interaction have in common is what motivates the user to interact. The essential might differ, but what they have in common is that none is driven by force, obligations or necessity (e.g. with work place system or internet bank). The interaction is by free will. Something that can affect how users perceive things like effectiveness. There is really no need to be efficient in either CM or game interaction, it can even reduce the feeling of progress.
Pagulayan et al describes a design process focusing on the designers vision of what kind of interaction that yield the best experience. I believe this approach could be fruitful in the design of devices aimed for the CM environment, However rather on focusing on how to maximize the experience, the focus should be on how to encourage an interaction that lets the user explore the most interesting states of the device. These states can be somewhat hard to find if you aren't familiar with the particular device and underling technology and an interface highlighting these would most likely also improve it's usability.

I't might not be obvious what the analogies, regarding what kind of encouragements or restraints, might be in the design of CM related systems or devices. One possible strategy is to bring out more interesting parameters (many devices and systems make no graphical distinction between common and less common used parameters).

6.3 Aesthetics affects

One off the thesis aroused from the interviews was that aesthetics might have a notably impact on the behavior. However, the open interview method, which is the basis for this essay, isn't very suitable to observe what kind of impact it might have, as this act on a more subconscious level. Any further discussion on this topic would only be wild speculations and I therefore pass it to further work.

6.4 Measurable interaction

Many of the sub processes in the CM interaction doesn't have to be a creative process. For example scrolling through files in a WIMP[31] environment, setting global system preferences or rearranging how the system present itself. Also devices that aim to present a more scientific approach to sound synthesis could be seen as less creative (assumed that the device is utilized that way).
In these interaction processes more traditional usability methods successfully applicable.

One of the usability definitions in ISO 9241-11 is a "positive attitude towards the product ".
This doesn't need to be in conjunction with a usable system (or device) in the context of CM. As this seem to be ultimately judged on the result utilizing the system, not on the system itself (in terms of features, ease of use, visual appeal etc). What I'm aiming at is that a system that a user finds usable, is most likely also awarded a positive attitude. But a system that is awarded with a positive attitude, isn't necessarily considered as useful.

Another measurable aspect, effectiveness, might not be as relevant as the motivation isn't driven by force and devices that do the work for you (something that indeed would be very effective) isn't always appreciated as the user don't feel that their personality is reflected in the result, imaginable or not. Also, a measurement of the task-completion-ratio makes little sense in CM environment as there might not be any obvious task to measure due to unintended use.

6.5 Target group

The unintended use of devices is a part of the explorative process of CM interaction and can render many evaluation methods useless. It might also be hard to narrow down a target group for a device if the most interesting utilization isn't defined. An illustrative example of this is the Roland TB-303, perhaps one of the most saluted physical devices in CM related communities (it also exists in many forms of software emulated variants.) This device was originally design to accompinate guitarists[32][33] but was received with very low interest from this market. After the product was considered a failure and pulled from production several musicians (i.e., CM producers) had found other use for it in guitar-free acid house music. The new way of utilizing the machine (i.e. device) aroused from the machine itself, but it didn't appear immediately.

In the chapter 'Interaction as intended by the designer' Pagulayan et al suggest that ones the interaction meets the vision of the designer, subjective aspects of how users appreciate the vision can be evaluated. If these evaluations yield a low interest, the conclusion doesn't have to be that the vision was an unsuccessful investment, but maybe that the wrong people was asked.

31 Acronym for Window, Icon, Menu, Pointing device and refers to a common computer operation system

32 http://www.synthgear.com/2009/vintage-synth-ads/roland-tb-303-ad/

33 http://en.wikipedia.org/wiki/Roland_TB-303

6.6 Distinction between realtime and non-realtime interaction

Less Cue Dependent (LCP) and Real-time Cue Dependent (RCD) Interaction.

I believe the CM interaction should be considered as expressive but it's not expressive in the same way as a traditional instrument that is dependent on cues (for example if playing a melody, the cues are when and how to play the notes). I refer to this as Real-time Cue Dependent (RCD) interaction. The interaction in a CM environment can of course also be dependent on cues, but not to the same extent, and it is not crucial for the result and I'll refer to this as Less Cue Dependent (LCP) .
That is, if a novel instrumentalist is dissatisfied with his or her abilities to interact with the instrument, it is related to motorical causes. The causes for a CM producer being dissatisfied relates more to a lack of knowledge.

There seems to be no explicitly stated distinction from realtime (i.e. RCD) and non time-critical (i.e. LCP) interaction. The expressiveness is nevertheless present in the CM environment, but following concerns might be taken in to account before making extensive analogies.
A live performance interface is necessarily limited, that is limited amount of individual parameters that could be presented at once. In LCP there is no need to change the whole system all at once, that is, more detailed options could be presented in LCP situations as a lag time between idea and realization doesn't affect the result in the same way as RCD interaction.
One of the more substantial differences is that in LCP interaction, more extensive unintended results can appear without being perceived as a problematic. In most cases these 'mistakes' can be reverted or corrected afterwards. The user doesn't have to master the system to success as a trial and error behavior is accepted.

6.7 Character of the device

M. Hassenzahl divides product character into intended (from the designers perspective) and a apparent character (as perceived by the user). I believe a more suitable distinction in the CM environment would be *perceived* intended character and apparent character of device.
As the name imply, perceived intended character is what the user perceives as the intended use by the designer (they doesn't necessary correlate), not as much in the sense of how to use it, but rather what to use it for. This character originate from presented features or prioritized functionalities (fixed sound and rhythms matched to a certain style, as the most obvious example), but also graphical metaphors used in the interface can communicate a certain contextual use.

The apparent character is perceived from attributes more originated from the the device itself. or from the use of it. An example would be analog vintage synthesizers , they communicate vintage analog, but also the associated features like history, warm sound, sturdiness, etc.
It doesn't have to be physical devices as 'vintage' computer software also communicates the time it origins from. These features or attributes are inherited form a much larger context then what could be communicated through the interface and they aren't a product of someone's design intention. They are the result of the use of the device, not only by the user, who perceives the character, but also other before who have utilized the device in different ways and associated the device these situations.
As Hassenzahl also describes, the apparent character can be evolve in the use of a device. For example customizable devices, that let the user create or change both the functional and the visual features. I believe this can create a more personal relationship to a device or system and in turn make them, not only more usable, but also more encouraging to use.

A distinct perceived intended character doesn't have to be something negative, but as the interview result indicated, a device that communicate a narrow way of contextual use, might not be a exiting one. However, if a device provide opportunities to be used in different context, it can still be useful. The distinction between these characters might not be distinct, but I't might be something to consider in the design of new devices, who often tend to copy a concepts from other successful devices instead of creating a new ones.

Another problem of communicating character is that it is perceived on a personal level, e.g a scientific interface might communicate that someone has put a lot of effort into the algorithm generating the sound, but it can also be perceived as the developers don't know how to program GUI.

A unique character of a device, doesn't necessarily come from its functionality (sound capability) or appearance (aesthetics), but also from how the interface is designed (type of input method, mapping etc) and what kind of interaction that is encouraged.
As character can imply a meaning (i.e. intention by the designer) and it's not possible to communicate neutrality one way of going around this would be presenting many characters (i.e. faces).

6.8 Interface resistance

A resistive element in the device can also have an positive effect, if It provide better possibilities for learning and therefore more possibilities for self development. These resistive element or limitations can provide resistance that the user has to circumvent, and in this circumvention this process satisfying results can appear.

6.9 Confidence in the sound

The product (i.e. produced material, music, sound, patch) is not separable from the process creating it, sound is the ultimate manifestation of the work put in to it, and as stated earlier, it's not always possible to have an objective view upon it, even if desirable.
What is described in terms of 'cheating' in the interview result section, would perhaps better be described as a lack of confidence in the sound. I define sound in this context as a partial result (not a completed song) commonly manifested in the form of a sound, but could also be a melody or other part element. In the creative CM process there is repeated decisions of whatever the newly made changes was for the better or worse. This decision is most likely primarily based on the sonic impression, but could also involve that some sounds in the current project are treated different on the basis of how they was made. Some sounds isn't removed, further processed as if they have a fixed state of satisfaction, or as there are a confidence in them.
Confidence in the sound arouse from the process creating it and can involve that the user has personally recorded them from other sources, processed them through expensive hardware or are a outcome of some tedious processes. The confidence could of course be a result of user who don't want to spoil earlier invested work without seeing a end result of it, but I believe it's more to it as even fairly simple processes can induce this confidence.
A possible explanation could be that if the sound is a outcome of personal process, the sound is also perceived as a personal expression, somewhat regardless off how it sounds.

This is perhaps one of the more interesting concerns in CM environments and can induce that the same result could be rejected or accepted based on the grounds of how it was created.

6.10 Immense possibilities

There seems like there's a lower tolerance for the amount options presented in the interface in a creative process. As the number of options isn't limited by the users intention of what to accomplish with the interface. Also, a feature-rich device is not easy to explore in what situations it will suit as best if the device has many states (i.e possible combinations of parameters). This might suggest why extremely limited devices can be found to be useful (the SP1200 for example).
This theory is somewhat also supported by P. N. Johnson-Laird, a cognitive psychologist who discuss psychological processes in modern jazz improvisation, a reference that, while from a different area and deals with realtime-interaction, might not be al to farfetched.
Amongst the possible conclusion, Johnson-Laird finds one as the most plausible:

> "Instead of forming wholly arbitrary combinations of existing elements, the combinations are constrained. It may happen that more than one option is consistent with these constraints. At this point, and only at this point, an arbitrary selection is made ..."[34]

That is, it is easier to find new ways if the number of options are constrained.

From a designer perspective it might be tempting to not exclude parameters as it will limit the functionality, look less impressive in a the feature list and in the marketing material (in software, the number of parameters doesn't even a relate to cost). This might be the cause of why many software devices have more parameters then what might be needed.

6.11 Relevance to other areas of interaction

In the first NIME proceeding N. Orio writes:

> "We consider that a bi-directional flow of knowledge between classical HCI research on input devices, dealing mostly with pointing and dragging material on graphical interfaces, and the design of new computer-based musical instruments can lead to improvements in both fields. "[35]

As much of the HCI research are not immediately applicable to to the CM environment (which also is noted in a more recent proceeding to NIME[36]), a appliance at the opposite direction might not be directly adaptable. This due to two primary causes: How the sonic and visual perception act and what motivates the CM interaction. Especially the what motivates can have some odd resulting effects. For example that limitations and a lack of control can not only be accepted, but also appreciated.
However, a aspect that might be interchangeable is how aesthetics in the interface might affect, not only the attitude towards the system, but also the interaction itself. An aspect that is preferably studied in CM environments as the affects could be easier noted.

34 P. N. Johnson-Laird chapter:'Jazz Imporvisation: A Theory at the Computational Level' -book: Representing Musical structure ISBN 0-12-357171-5, 1991, page 321.

35 Input Devices for Musical Expression: Borrowing Tools from HCI, pp NIME 2001 by Nicola Orio, Norbert Schnell and Marcelo M. Wanderley

36 HCI Methodology For Evaluating Musical Controllers: A Case Study - Chris Kiefer, Nick Collins, Geraldine Fitzpatrick NIME proceeding 2008

Chris Kiefer, Nick Collins and Geraldine Fitzpatrick -2008

6.12 Self-criticism

My own experience from CM environments might not only been to advantage as I probably had some pre consumptions about what CM interaction would imply. This could in turn have colored the interviews and conclusions in a non objective way, even though unintended. Regarding the interviews however, most off the interviewees was straight forward and dismissed some off my statements when they didn't agree. This work might not either been possible within this time frame without some knowledge of CM, especially about how the technology in question operates (e.g. interface, functionality etc).

Another thing that reduced the quantitive reliableness of the interview results was that the interview questions was edited for each interview as new interesting topics aroused that I hadn't thought of or as I found how to introduce them in a successful way. Because of this the first interviews gave less interesting information and acted more as a method for collecting good topics or question to discuss. As these topics and questions was present in the following interviews they also yielded more interesting result. More interviews would probably also have contributed to more reliable conclusions.

7 Conclusions

It might not be possible to draw any general conclusions on what makes a device useful as it seems highly dependent on the context. That is, a device that most users render as useless, can still be appreciated by others in certain (musical) situations. It might also be worth considering that how a device sound have a large impact in the choice of devices and can sometimes be the first criteria.

7.1 Usability aspects

Immense possibilities
Endless possibilities directly presented in the interface demands endless of decisions of the user, something that can be overwhelming, especially in a creative process.

Not easy
A device that is 'too easy' or 'too smart' in the sense that it is doing to much automated work - have no learning curve and therefore provides less possibilities of personal development which in turn could make it less interesting. Nor does easy devices give the same extent of confidence in the sound. They might be suitable in some situations, but it's still a consideration. It might also be hard to make a device both easy to learn and interesting to explore.

Many of the key element in a track is a result of unsystematic exploration of an interface or the reuse of earlier tactics discovered this way. - Good systems (these tactics commonly involve more then one device) should provide opportunities to discover these tactics.

Justified appearance
The user is more likely to be satisfied with the result if the interface reflect the functionality of the device. If a device have an all to promising appearance and the user isn't satisfied with the result it can induce a feeling that the user just don't utilized it the right way. A interface that communicate low expectance is more likely to encourage the use as a user easier can relate progress to his or her interaction and not the device.

Instead of presenting (in presets, or introduction examples) the states in which the device is as most pleasing or effectually. Present a wide palette, even those states that can be perceived as ugly or bad as this to encourage the different use of the device.

7.2 Possible solutions

7.2.1 Device faces

Taken the above discussion into account I suggest a design-model for GUI's that I've name 'faces'. A device face is a way off presenting the same device in different ways. Ways that highlight different aspects of the device by combining and excluding different parameters. Faces should represent a sound, both in layout and mapping. Each face could be created or edited by the user and result in a more personal relation between user and the instrument/face/device. This could also eliminate 'being a slave under the designers intentions' as every face could be changed only slightly and the face would be a product of the user, not the designer (less intended design).

- Faces provide a sandbox environment, foolproof, but with preserved possibilities.
- Each face represent a character that highlight a aspect of a device and encourage the user to utilize this aspect.
- Faces present a limited interface options primary, many options and possibilities secondary.
- Faces divides a device for different interaction, a expressive mode(i.e. face-mode) and a more methodical exploring mode (changing or creating faces).
- One synth-engine (or effect algorithm, sequencer etc) can provide for many faces as faces just highlight a aspect off the device. Every preset could be a face instead of parameter settings.

This model exist to some extent but is commonly a somewhat painstakingly process (e.g. PD, Cycling 74 max/msp, NI Reaktor) and operates on a more functional level then within the interface. They also demands a lot of knowledge of the user and the learning curve is steep and while providing almost endless of possibilities, this could also be somewhat overwhelming.

Other existingimilar models have very simplistic apapproach Native Instruments Kontakt software for example, which provide two parameters presented on a x-y plate with the functionality of 'morphing' different presets. (ii.e. morphing between successful states) this might be interesting for some users, but is likely to be perceived as somewhat limiting and uninteresting.
Some simplistic approaches seem to have a keyboardist in mind and the parameters affect the sound only marginally to not ruin a live performance.

Another existing approach is in the device plugin Drumrack within Ableton Live (version 8 and later). Where a parameters from each drum sound can be assigned to a 'macro knob' which is always present in the interface. However, I believe more could be done with this model.
Faces might not be suitable in all situations, for example where a overall system feedback is desirable (e.g. mixers) and should not be considered as a general solution.

The most problematic in the design of devices with faces is how to provide an environment that link the extensive device mode and face-mode as mapping could get complex.

7.2.2 Snapshots

Snapshot is only vital in systems providing separate views for sketching and arrangement (Ableton Live for example).

In the transition between these modes a idea can get lost, or the state in which the system sounded good could get lost. One of the user that utilized separate machines (i.e. devices) for these two didn't

have this problem as it was a fixed transition but with the tradeoff that early decisions was costly to change later.
A solution to this could be simple 'snapshot' to compare the current state off a device or system and the state when the user last took a snapshot. It should also be possible to revert to the snapshot state individually for each device, for several related devices, or the whole system, as many changes made might not relate to what the user wanted to preserve in the snapshot.
Snapshots would minimize the need to memorize previous changes if new musical examinations is made.
This is somewhat already implanted in devices aimed for mastering, where there sometimes exists two possible states of the system which the user can toggle between to conclude whatever changes are for the better or worse.

7.2.3 A character mapping test

Something that might be problematic while designing devices for the CM environment is the unintended use of them. One way to test unthought use could be to randomize the input data (also the note input if it's a synth or sampler). The randomization could be weighted against how highlighted a parameter currently is in the interface. For example if some 'hidden' parameter have a default value, most input test will have this parameter in its default state.
This test could yield several points of helpful information:

- There might be (musical) interesting states of a device which the designer haven't thought and these states could then be incorporated in a more clearly way in the interface, if they not already are.
- The designer might have an idea of what is a successful use of a device, if most tests yields different results then what the designer had in mind, perhaps some parameters should be removed, alternative mapped or moved further back in the interface (i.e. make them less highlighted).
- If most test results sounds uninteresting or undesirable (from a designer perspective) the mapping could be adjusted to exclude these uninteresting intervals.
- If most result sound more or less the same, perhaps more parameters should be included or highlighted in the interface.

This test might not be suitable to a complete system as these have other considerations and with more extensive devices it might be wise to focus on different aspect one at a time.
If it is used in a correct way the character of the device is somewhat more truly revealed.

7.3 Future work

Ass noted earlier, the number of situational unique concerns in the CM environment could be further explored by more interviews and as the conserns seem to vary between induviduals, more research would contribute to conclude which considerations that are more general then others.

8 Appendix: Interview questions

Note: These questions was more used as a manuscript for the interviews and doesn't completely reflect the content of the interviews.

What do you emanate from when you start a new project?

Can you give an overall description of your working methods?
Is there something as cheating?

Do you think you judge music different if you know how it was made?

If you would replace the current system to another with the same functionality, do you think your music would sound different, even if you knew both system equally well?

Are you satisfied with what you produce or do you often feel that you should have done something different?

What makes you want to explore something (i.e. device or system)?

How do you think your choice of tools affect your music if at all? (not just audio)

Do you have any method to generate new ideas, or is this not desirable or a problem?

Does it occur that new ideas arise during your work process and is so, how do you relate to them?