GESTURE AND MUSICAL EXPRESSION ENTAILMENT IN A LIVE CODING CONTEXT

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ABSTRACT

This paper considers issues and implications of gesture and musical expression for live coding performance. In reviewing the broader relevant literature and its interpretation in digital music research, it seemed logical to reflect on how musical gesture and expression might evolve in such generative sound practices. Indirectly this research raises the question of what live coding is capable of facilitating in the context of realtime performance and how and why live coding languages could evolve in this respect.

1. INTRODUCTION

The practice of live coding reflects a curious disjunction in the evolution of computer music. Although it might seem retrogressive, the practice does reflect maturity, re-asserting the primacy of language and extending that into the realm of extemporized dialogue between performer and instrument as public performance. This creative practice runs parallel to the general trend of explicit functionality through Graphical User Interfaces or more explicitly, patching. The debate over which is a more effective engagement in creative practice continues with important arguments from both sides[1] if the wider context of computer music activity is considered. Let's say, however, as a matter of closure on this, that for some the idea of live coding is profoundly intriguing.

Several important texts, Nilson [12], Blackwell and Collins [3] and Brown and Sorensen [6] discuss live coding from the central positions of programming languages, mathematical formalisms, generative systems, historical evolution, performance practice, relation to the traditional instrumental skills and wider implications for computer music. From these seminal texts, the prospects for live coding can be extrapolated to a number of important creative prospects. Perhaps the most curious of these is a view articulated by Whitelaw [22] where live coding is essentially data manipulation in realtime. Whitelaw states about live coding:

> "Whatever else it says, it also says, "watch what I do with this data." It displays a data literacy, an ability to acquire, munge, filter, process, map and render. Since it's primarily operating as art, rather than functional visualization / sonification, it also demonstrates a process of translating or mediating between these domains."

While it is possible that live coding could singularly embrace such a data aesthetic (infosthetics) practice, of interest here is the extent to which the practice inspires lateral thinking and expectations of new creative directions.

Returning to the musical context, Nilson [12] provides one of the most illuminating and personalized accounts of what it is to be a live coder and the parallels with traditional instrumental practice. In fact, much of the discourse found in the three seminal texts mentioned earlier, concern the pragmatics and public reception of live coding as a musically creative activity.

Although a relatively new practice[2], live coding does draw upon a wealth of knowledge in language development and major advances in computational hardware. Consequently, it does seem a logical development in the evolution of computer music. Indeed, it appears veritably fecund with possibilities beginning with the number of software applications that can be used and those that have been developed explicitly for that purpose. Apart from addressing existing and particular issues surrounding interactive music, live coding arouses curiosity in regard to what further creative possibilities await to be discovered. An example of this is the collaborative practices of *PLOrk* [14] and *aa-cell* [18] that suggest a more sophisticated outcome, intensification and contemporaneity in the "live" dynamic.

It is obvious that live coding concerns circumscribe a particular view of the mind/body creative interaction, which is somewhat unprecedented. Nilson [12] observes, "It is helpful to first disassociate control and physicality." This has huge ramifications even within the electronic music fraternity with those who believe the human body crucial to all musical expression. Yet

[1] A Coding vs. Patching thread on the SuperCollider Users mailing list from 24-04-09 debated issues including computational and cognitive efficiency, process comprehension and pedagogy. The discussion petered out with refutations from both perspectives that advanced neither approach over the other.

[2] See toplap.org/index.php/HistoricalPerformances for an evolutionary overview.

creative production and indeed, musical expression also require levels of abstraction that "don't have an immediate physical analog" Nilson [12]. It is clear that greater abstraction–the construction of complex sound events–is a key strength of live coding. In this respect the public experience has been augmented with a simultaneous visual presentation of the coding process even though as Sorensen and Brown [18] point out, "However, even with a strongly technical audience, complete comprehension of the generative ramifications of the source code being run during a performance is challenging". Nevertheless, the evidentiary spectacle does serve a purpose as confirmation of interaction and causal relations. While there is clearly something inscrutable about dynamic code presentation, for some of the audience it can become quite engaging as the performance evolves and the musical result becomes compelling.

2. WHY EXPRESSION

What is absent in certain practices of electronic music is evidence of a physical relation between the body and sound production as is widely understood in traditional musical practice. There are two approaches to looking at this. Across electronic music genres, it is either not important or not relevant to the nature and style of music or it is. So not all electronic music benefits from or is enhanced by a correlation between human physical agency and the sound. But the instrumental paradigm is difficult to ignore. Watching someone playing piano is to observe a physical engagement in the production of sound, which we identify as "effort" and in a more refined state becomes externalized emotion mapped to the sound. Sometimes it is genuine and sometimes affectation but the behaviour is considered mandatory for most performance to achieve expressivity. The question of "Liveness" as discussed by Croft [9] reflects on how electronic music evolved with the absence of "body presence" in many of its contemporary genres since the middle of the Twentieth century. It is worth noting that this status is probably undergoing a state of reversal as various performers are currently returning to some type of human performance or instrumental engagement with computer technology. Having an identity as a performer maybe putting some balance back into the electronic music studio production context. Not to mention simply reinvigorating live electronic music even if live coding is seen as a controversial practice.

A corollary to this is whether it is necessary for musical expression to be based on traditional instrumental practices at all. In recorded music, without visual referents, it is an allusion. The listener must interpret and respond to the nature of the sounds. So is interpretation and appreciation of expression possible when there is a human presence but no visual correlation of human action? Laptop performance is a classic example of this, where the process of sound production and physical interaction appear to have no connection with human effort. Perhaps it is more appropriate to say that little attempt is made to establish a connection. In contrast, live coding takes a different view of this issue in a performance context and thus opens discussion on the extent to which creative effort can be manifest.

Thus intrigued by the prospects of live coding, the idea for this paper arose from discussions about how certain sound events could be given more expressive characteristics during a live coding improvisation. Now, it should be understood that the approach to gesture generation under consideration may not be appropriate for all musical forms or for all musical material being constructed within a given performance. Specifically, it is directed towards musical material deemed to be of an expressive nature and understood to require such nuance. For example in a simple case, melodic material without such tweaking might simply sound mechanical and characterless. A point of reference for this research was performance characteristics in certain Jazz styles and idioms. On reflection, the prospect of live coding practice accommodating and attaining such a level of expressivity and individualism is too compelling to pass without comment.

Given that any kind of expressive superimposition on musical material implies an additional creative burden for the performer, a central objective of this research is to discuss the value of including such performance overhead cognizant of the demands of creating new sound structures. This would seem a profound consideration with even a partially generative approach to live performance. In challenging live coding performances, effective expressive coding might be too demanding to implement in a given time.

For a live coding performance in which sound material is defined numerically or by predetermined structures or generative processes before execution, it begs the question as to how one would know firstly, if the material needed such nuance and secondly, what such expressive control would be? If we think in classical terms of a melody for example, typically it is a more or less fixed form, can be understood during rehearsal and in the composition usually repeated at various times. It is therefore possible to focus on an expressive articulation of the melody. With live coding it is perhaps possible also if there is a reasonable window of opportunity. So it is conceivable, given enough practical experience, that an understanding of how to shape particular sound events could become simply another live coding skill. After all, that is exactly how it works with traditional instrumental music.

3. GESTURE AND MUSICAL EXPRESSION FROM THE PHYSICAL PERSPECTIVE

A review of some of the literature surrounding gesture and musical expression reveals the extent and diversity to which the subject has been researched in recent years. A sample review covers analysis, trends and synthesis [1, 2, 7], mapping and controllers [4, 10, 11, 13, 15, 20], and beyond sound [10, 15, 21]. This is to gaze into only a fraction of the research. Many researchers consider the

most effective solution to be based on external controllers with a fundamental understanding derived from an analysis of traditional musical instruments characteristics [8, 17, 19]. This is a logical starting point, as external interface devices have a direct relation to musical instruments and an implied connection with musical expression at the physical level. In this respect, models of gesture and musical expression can be analyzed and understood from a wide variety of traditional musical instruments and performance practices. Of interest at this point is, whether the expressivity of such controllers is largely predicated on existing instrumental skill and whether that impacts on the prospect of electronic music developing unique forms of expression. There are also controllers that have no connection with traditional instruments but explore the idea of gesture from other aspects of human movement and language. Often the extent of such research is too rarified to have a significant impact on the electronic music community.

The question that arises here is are controller paradigms constraining the development of contemporary musical expression in the electronic domain? Must the future of musical expression be conditional on human physical gesture as the context for musical expression? This question permeates the intention of this paper, as clearly this would be somewhat limiting. The concept of musical expression, in generative music, may need to be appreciated through a more abstract understanding of the nature of control as experienced through sound events uniquely improvised by the live coder.

Of particular interest regarding gesture analysis from an instrumental perspective, is the research of Levitin et al [10] and Rovan et al [15]. Levitin and colleague's analysis of a musical event provides a fundamental framework that is almost universally applicable. In short, they are considering the control of a tone in a monophonic context, the *attack, steady-state* and *decay* or beginning, middle and end form as axiomatic to how we perceive musical events, whether as one note/sound or a melody. The mapping strategy used by the authors is "the linking or correspondence between gestures or control parameters… and sound generation or synthesis parameters." These "should exploit some intrinsic property of the musician's *cognitive map* so that a gesture or moment in the physical domain is tightly coupled – in a non-arbitrary way – with the intention of the musician."

The research of Rovan et al, discusses gestural mapping strategies with a specific focus towards a practical outcome employing the Yamaha WX7 wind controller interfaced with IRCAM's FTS software running an additive synthesis engine. Of interest here is their discussion of a 2 dimensional expressive timbral subspace mapping. This is defined as four quadrants formed from the intersection of points where X is pitch and covers a 2 octave range (F3, F4 and F4) and dynamic levels (pp, mf ff). While they point out that the approach has existing parallels with sample synthesizers, they observe, "By considering the additive method, we consider interpolation not between actual sounds but between models, and thus the issue of modeling is central to our work."

In both research cases, implementations use an external controller. So although the data from the controllers is digital, the important aspect of timing in musical expression can be derived from the performer, as well as visual performance cues for the audience. If computer music controllers are considered in a more experimental context, such as those described by Cook [8], musical expression could take some interesting new directions. While Cook's constructions are predicated on some kind of musical instrument other systems like that by Overholt [13] and Van Nort [19] are based on sophisticated and novel physical interaction that have no immediate association with traditional instrumental practice. Yet the aspirations of use are quite specific, if not ambitious, Overholt writes:

> "Instead of requiring excessive musical knowledge and physical precision, performers will be able to think about music in terms of emotional outputs and the gestures that feel natural to express them. This should let the musician to go much more directly from a musical idea or feeling to sound, thinking more about qualitative musical issues than technique or physical manipulations."

Exactly what music the author is referring to cannot be appreciated from the paper but can be deduced to have at least reached initial expectations.

Research into musical expression and gesture based around controller development would appear to be universally accepted and in fact encouraged at an experimental level. Sometimes it seems with indifference to Cook's [8] *Principles for Designing Computer Music Controllers*, for example, number 5, "Make a piece, not an instrument or controller" which seems an important and astute observation for experimental research with creative aspirations. Reflecting on that principle a bit further, the implication is that the construction of a controller should not be based purely on the nature of the controller itself, without a vision of what creative outcome could be achieved. Yet who would know what that might be? The unexpected is fundamental to the prospects of experimentation.

Development of physical controllers has the initial and time consuming stage of constructing the device itself before progressing to issues of data output, mapping strategies, sound production and composition/performance. In this respect, approaches to gesture and musical expression are implicitly considered in physical terms from the outset.

Another view of gesture is from the musical perspective. Arfib et al [2] comment, "Using musical gesture relates to the musical meaning given by the sound performer, meaning which we can extract from

the signal, with long integration time, for example transition type–portamento, legato, pizzicato–and modulations–vibrato, roughness." So what are the prospects for gesture and musical expression when a physical device is not implicit? Possibly good but ambivalent, consider Arfib et al again, "Note the effect of physical gesture appears in musical gesture, even though we cannot always notice it." It should further be noted that this research into physical gesture and its correlation with musical gesture was intended "to permit the design and development of human-computer interfaces better adapted to interpretation and improvisation." Although in this case there are physical controllers involved at the research front end, why should musical gesture research not be undertaken independent of such a starting point?

4. LANGUAGE AS INTERFACE TO EXPRESSION

How might sound applications that employ a programming language as a means of performance, negotiate gesture and musical expression? Throughout this text what is meant by gesture or musical expression has been left solely to the readers experience and understanding. It seems fair to say that most informed views begin with experiences from instrumental music and pedagogy. For example, the term, 'cantabile' can be understood to encapsulate a very specific relation between gesture, as originating through physical action and musical expression as an invocation of emotion in classical music. Its application and relevance to the evolving world of computer music might seem limited and perhaps anachronistic but the ability to effectively execute that well understood musical term in a live computer music context raises some interesting questions.

While live coding is an empowering means of production, it brings with it a formalism whose origins are not from conventional music practice. It is therefore, a unique form of cognitive engagement at a creative level but issues of extensibility and sophistication are not yet widely understood. Knowledge of live coding practices that lead to more sophisticated and nuanced performance will coalesce over time and through wider use and experience of creative outcomes. If multiple applications exist for live coding performance, what points of commonality do they share? This question has yet to be systematically addressed but has beginnings in discussions by those who are active practitioners. Sorensen and Brown [18] observe:

> "Our approach revolves around setting up generative processes, and the dynamic nature of live coding allows the performer to direct these processes. Live programmers not only write the code used to generate the music, they also constantly change and modify the behavior of that code dynamically throughout the performance. In this way the live programmer controls higher level structure, directing processes like a conductor directs an ensemble."

No matter what languages or formalism are used for live coding, there will be a tendency towards refinement that facilitates the construction of sophisticated sound events and hopefully, their expressive articulation. One might expect that this would lead to defining means of gesture and musical expressivity commensurate with the nature of the mode of engagement.

5. PROPOSITIONS FOR CODING EXPRESSIVITY AS PERFORMANCE

After negotiating the wider context of musical expression in the computer/electronic music context and considering pertinent aspects of live coding, the following propositions are intended to address issues specific to defining what musical expression might entail in this context. The relative importance of these propositions is a matter of practical consideration and engagement, and not of overall concern here. There are clearly points that overlap and converge and are bilaterally influential, but again that is more pertinent to later implementation discussions. It also has to be acknowledged that these points need wider discussion and explication.

5.1. Musical Expression as a Universal Condition

Understanding gesture and musical expressivity depends on experiencing and acknowledging the emotional effect of musical structures. These can range from a single sound of arbitrary duration to complex sound aggregations. In the case where sounds are uniquely electronic in nature, the concept of musical expression is fundamentally abstract and may require a specialized interpretive approach. But recognition in the listening experience that sound contains something of the humanity of the performer (in this case a cognitive state) one that it is transfigured, is something to aspire to.

In much contemporary electronic music, expression that is traditionally understood may not be relevant, applicable or achievable. This condition should open up the possibility of a meta-level condition arising as a maturing consequence of the practice.

5.2. A Language Framework for Expressivity

Live coding is a trajectory from the submission of a symbolic notation to interpretation to sound in a spontaneous act. An excellent overview of necessary conditions for a live coding language can be found in Blackwell and Collins [3], Brown [5,6] and Wang [21]. Within the nature of the symbols, syntax, grammar and overall language implementation lie the potential for defining the production of sound deemed to be infused with expression.

Therefore, a language specification that permits development of constructs for gesture and musical expression is a reflection of the sophistication of that language. They also need to reflect expectations of the

effect on the sounds to which they are applied. This is challenging because they could be personal and additionally inscrutable. Experience becomes the only means of predicting a reception of success.

5.3. Pre-configuration of Expressive Structures

The pre-configuration of functions and structures for a given performance is likely to be a necessary and evolving condition to the production of more sophisticated and subtle performances. This suggests that some initial thought as to what will be performed and how, will require follow up coding in the form of specific macro structures. A language of any sophistication would allow and facilitate this.

Further to this point, the nature of expressive structures are likely to be defined in the context of control data influencing audio signal amplitude, frequency, event timing and diffusion. This is not an unfamiliar activity to electronic musicians. However, to consciously consider performance as control and at a symbolic level, independent of sound production, raises some interesting thoughts, particularly in the way one might have learnt the language in the first place.

5.4. Expression in a Visual Form

An integral part of live coding is the visual presentation of the code itself. The dynamics of this evidence is remarkably revealing of the performer as much as it is of the sound. The idea of presenting in code, expression being applied to the sound, is a seductive extension to the performance.

Evidence of expression could be deployed to another representative level within the visual context. Perhaps in a distinct form and location to the code itself. This could however, be too distracting or confusing. Alternatively, integrating a graphic representation under the code might be more subliminal. This representation could fade over time and may only be present to indicate a shift in the performer's creative focus. This may complicate the relation with the code, which may not be responsible for that expression. However, it might work well with re-entrant non-linear code blocks.

This visual form has been in part realized already. Andrew Sorensen, in performance in 2008[3], employed descending coloured patterns synchronized with the sound to some effect. Extending this to reflect expressive intentions in performance therefore might not be that difficult to implement and a first step towards the visualization of expressive intention.

5.5. An Idiomatic Terminology

The historical and musical implications of gesture are undeniably influential in all musical activity but in the context of live coding the term's physical connotations are clearly less relevant and accessible. The term, 'musical expression' seems more inclusive and flexible in the evolution of electronic sound. It is conceivable that the practice and results of a meta-level shaping of sound in live performance might be understood through the establishment of a terminology more applicable to the genre. Such terminology might be in the form of code, and would significantly distinguish it from the terminology of traditional musical practice but it may lack universal coherence.

5.6. Prospects for a Unique Genre

Ideally, live coding would facilitate a particular style of music over time. It is conceivable that it would have less of an emphasis on sound and technology, and more on contemporary idioms of composition, improvisation and general music making. However, this is likely to depend on the performer, the language they use and the context in which they perform.

Another critical matter concerns pedagogy and the cultivation of a community of users. In the current climate of electronic music practice, a clear incentive to embark upon the learning curve of live coding would be a clear potential for creative individualism beyond what is possible with the common performance applications. This remains a matter of reaching a critical point in public musical awareness of what live coding can express.

6. CONCLUSION

This paper was written with a personal vision in mind of what musical expression, in the context of live coding, might entail. It had its origins in preliminary thoughts around the idea of a physical, indeed, tangible surface that displayed contours, which would be mapped to structures controlling expression. However, thinking this through resulted in a return to consideration of the primary mode of engagement, the language itself. This paper has not had a specific language implementation underpinning it rather it has taking a deliberately abstract and philosophical view. Consequently, as preliminary research, it is intended to inform approaches to later technical developments.

In the course of writing this paper I have personally reflected on the cognitive relation between programming and the ability to produce and appreciate sound events that achieve a sense of humanness or expressive agency through abstraction set in varying degrees of immediacy. Interestingly, a tradition instrumentalist must constantly make a sound while simultaneously listening and adjusting in order to appreciate its expressive effect. A live coder, while also being able to alter evolving sound, has opportunities for reflection while their generative constructs unfold in time. In this unique boundary world between performance and composition, perhaps the meaning of musical expression will be in the form of a deep awareness of and creativity with complex event sequences, a fluidity of response and the imposition of a unique identity in creative outcomes. In essence, those indefinable properties: style, experience and character.

[3] *Transmissions in Sound.* ANU. October 15, 2008.

The only effective way to reveal such aspirations is through reflective and sustained performance practice. This practice would inevitably lead to an intimate understanding of engagement, and personal extensions and refinements to the formal language. Whilst a fascinating prospect for this distinctly cognitive practice, inscrutability may become idiosyncrasy, and ultimately through a cognoscenti, acquire public acceptance and recognition. Although live coding seems counter intuitive, it uniquely combines the reflectiveness of composition with the spontaneity of improvisation. Such a singular and evolving creativity at least parallels and rivals the intellectual dimensions of traditional instrumental practice.

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