

How Live is Real-Time ?

Kerry L. Hagan

Digital Media and Arts Research Centre

University of Limerick

Kerry.Hagan@ul.ie

Abstract

This paper is predicated on the argument that real-time computer-generated music exists on a spectrum of ‘liveness’. First, a brief discussion of liveness situates the question of liveness in real-time computer music. Then, comparing terminology for liveness in real-time computer music characterizes the issues involved. Finally, several musical examples delineate the liveness spectrum in question.

Introduction

What does it mean when a musical work is ‘live’? Although the question implies a categorical distinction between live and not-live, this can easily be dismissed with a few pointed questions. What does it mean to be live in acoustic music? What does it mean to be live in *electroacoustic* music?¹ The answers suggest that there are no definitive categorical distinctions between live and not-live, rather there is a scale of ‘liveness’.

In a move that is both limiting and complicating, this paper specifically addresses ‘what does it mean to be live in real-time computer music’? This is both a focusing question and a new problem, because what does it mean to be real-time?

Emmerson (2007) acknowledges the complicated case of computer music, and several authors discuss real-time computer music. These authors’ concepts implicitly and explicitly impact on the evaluation of liveness in a work. In addition to the inherent difficulties in assigning liveness, the application of the label ‘real-time’ is not straightforward.

This paper examines a number of musical works as case studies with the aim to circumscribe the spectrum of liveness. In doing so, liveness becomes a multi-dimensional space determined by a number of factors, and real-time computer music can exist on many degrees of liveness.

Liveness

What is a live performance? In acoustic music, this question appears to be straightforward: a concert is live, but a recording is not. However, looking closely, a quagmire of ambiguous cases arises. For example, recorded music that is edited, mastered and produced in a studio differs from so-called live recordings. The live recording captures spontaneity, risk, an acceptance of error and fault, and an experience closer to a live concert than the studio

¹ Electroacoustic music used here signifies any music that relies on, in part or whole, electro-mechanical means of production.

recording. Consequently, the inclination to assume all live performances exhibit the same degree of liveness contravenes the different experiences that grow from different live music-making. Performances of precisely notated scores, performances of symbolic scores open to individual interpretation and completely improvised music (a kind of real-time composition) all position works within degrees of liveness.

These categories of musical realisation uncover aspects of what one considers when thinking of live music: spontaneity, living presence, indeterminate influences, risk of failure, acceptance of error, audience experience and other contributing factors. Though individual listeners may rate these musical encounters differently, these factors clearly transcribe a multi-dimensional space conferring liveness.

In electroacoustic music, the range of possible human interaction compounds the issue. Some electroacoustic music is fixed as a recording, and others change with each realisation. Further, these facets are uncorrelated to the extent to which humans input or interact with the music. These characteristics introduce more variables to the multi-dimensional space of liveness.

Emmerson (2007) wrote comprehensively on what makes electroacoustic music alive. He problematizes shades of difference, arguing quite convincingly that even fixed medium works create a living presence through human reception. In his discussion, he acknowledges tricky ‘borderline’ cases, one of which is the example of machine-generated music without human interaction. In this paper, this borderline case is narrowed specifically to real-time computer-generated music, but broadened to include levels of human interaction, human control and computer autonomy. This focus illuminates the problems with nomenclature as well as directly addresses the relationship between live and real-time.

Real-time and Non-real-time

Nearly every discussion of real-time defines it as a dialectic. However, the different terminology authors utilise reflects their own aesthetic and philosophical stance on the issue. When comparing the authors’ definitions, a wide range of what is considered to be real-time emerges. This paper argues, through these definitions, that real-time is a complicated scale, not a categorical qualification.

Puckette (2004) does not explain his dialectic of ‘compositional’ and ‘performative’, but his description of challenges in developing Pd gives rise to his intentions. He approaches the categories from a programmer’s point of view: things that must be scheduled in a pre-composed, timed order versus things that happen freely. He refers to the former as ‘compositional’ and the latter as ‘performative’. The performative seems to rely on human input or triggers, as well. Yet, composed elements often trigger real-time processes.² The boundary between compositional and performative is not clearly distinguishable as non-real-time or real-time.

Seleborg (2004) also tackles the difference from a software perspective. His words, real-time and time-deferred (or time-delayed depending on one’s translation of *temps-différé*) reflect the original purpose of such tools as Max (real-time) and OpenMusic (time-deferred). OpenMusic facilitates computer-aided composition. CAC is traditionally considered to be a

² The interesting insight here is that, though Pd is a music programming language intended from its inception to be a real-time tool, there is demand from its users for scheduled, pre-composed elements.

non-real-time process; the composer programs the computer to generate materials, which he or she then translates into a symbolic score for human performance.

From this, Agostini and Ghisi (2013) attempted to bridge the gap between offline CAC and real-time processes. Their software, *bach*, allows for Max to generate symbolic scores in real-time. This allows for the architecture of Max, software intended to be performative in Puckette's terms, to be a source of CAC, resulting in human-readable scores. Agostini and Ghisi refer to traditional CAC as 'speculative'. This word suggests that composers working with CAC do not know what their results will be with each program. However, most seasoned composers have some idea of their algorithm's output, with only occasional surprises. Therefore, perhaps 'notional' should replace speculative.

The phrase 'algorithmic music' carries with it enormous baggage. In some instances, a speaker may be referring to completely computer-generated, highly formalised music. In other instances, a composer may simply refer to anything generated by an algorithm. Collins (2003) is careful to use 'generative music' for the materials used in real-time laptop performance, although he occasionally refers to algorithmic composition. Perhaps this is a nod to the fact that real-time generative music must rely on algorithms, while accommodating the connotation that algorithmic music is autonomous and non-human. He elaborates various approaches to live laptop performance and advocates for audience education. He makes a subtle distinction between performers using off-the-shelf software and performers using programming environments such as Pd or SuperCollider (another real-time music tool). Those who use off-the-shelf software typically rely on pre-programmed actions more than those who do not. This reflects the reality that, though live, laptop performers can still be using software to simply trigger pre-programmed sounds, passages, gestures, loops, etc. In his discussion, he acknowledges that performance can consist solely of a mouse click or key press, but that the audience needs to learn, somehow, that these are performative actions (to use Puckette's words).

Garnett (2001) carefully delineates what music is interactive by its aesthetic implications. In the broader genre of performance-oriented computer music, where there is at least one live performer in the mix, he contends with the sub-genre of interactive computer music. His argument is that any human interaction, 'while it can of course be minimized (the stage can be so darkened as to prevent his or her making any visual effect, or his or her role can be minimized to be no more than a button-pusher of one kind or another, etc.), can open the work to aesthetic values that frequently remain outside less interactive computer music' (p. 25). For Garnett, interactivity is the key to live performance. Still, a button-push tends to stretch the term interactive; after all, even fixed-medium works without live diffusions require someone to press a button.

There is consistency between Garnett and Collins in what minimal actions a human performer may take to make a live performance. Garnett never refers specifically to real-time computer music, though material that responds to human interaction can be as fixed, indeterminate or real-time as any laptop performance. So, Garnett's discussion does not differ wildly from Collins.

Similarly to Garnett, Rowe (1999) asserts that interactivity assures liveness, that 'the musical values evinced in interactive compositions are ultimately the same as those underlying a string quartet' (p. 87). Unlike Garnett, Rowe does not make a constitutional stand against real-time computer music *without* a human performer. Though he distinguishes between real-time computer music with and without human interaction, he does not privilege one over the

other as more live, simply more interactive. Rowe also alludes to the notion of a computer as performer. It follows that, once a computer becomes performer, it becomes a live manifestation, a kind of artificial human presence.

Perhaps then, the extreme of this idea can be found in Lewis (2000). In his work, the computer-as-performer is elevated to the equivalent status of the human performer. He argues that this multi-dominant approach exists outside the pan-European experimental ethos. There is definitely a notion of liveness in his work, in that both computer and human performers are improvising: responding to each other, listening to responses, accompanying or initiating new material. As the computer is improvising, it is necessarily composing in real-time with a significant degree of autonomy.

From these authors, real-time and non-real-time are identified as performative versus compositional, real-time versus time-deferred, performative versus speculative (or notional), generative versus algorithmic, interactive versus non-interactive, improvised versus notated, indeterminate versus fixed. By examining these dialectics from a distance, however, each implies diverging interpretations of real-time and live. Some of these positions overlap, while others cross orthogonally, forming complex intersections. The best way to untangle these ideas is to ground the dialectics in musical examples.

Case Studies

Some meta-dialectics that emerge from the discussions above may establish the issues of liveness in real-time computer music. One distinction is the degree to which output is indeterminate. To be perfectly accurate, none of the examples discussed by authors above are truly indeterminate. Though apparently random to our ears, software programs that use statistical probabilities rely on pseudo-random number generators.

One might be inclined to think of improvisation as indeterminate. Though aspects of improvisation may be open to real-time decisions, human improvisers are never indeterminate. Their responses are composed, even if they are composed on-the-fly. Therefore, the dialectic of notated versus improvised is a separate issue from determinate/indeterminate.

Another dialectic, recorded versus live, seems a good distinction to use with real-time computer music. However, elements of recorded passages can exist in real-time performances, so this dialectic is non-trivial.

Determinate versus Indeterminate

The works most accurately described as indeterminate are works that utilise statistical probabilities to generate material. Many contemporary examples use these algorithms to create music in real-time. My own works, for example *real-time tape music III* (2008) and *Morphons and Bions* (2011), use such processes and do so in real-time; real-time processes even control multi-channel diffusion (Hagan, 2008; 2013). Each performance is unique. However, the form of these works is pre-composed, consisting of a series of timed messages that change the parameters for the processes. This ensures that the works are recognizable as the same piece, even if side-by-side recordings show that the details of the works are different. There is an ontological discussion to be avoided here. But, the nature of these works' existence relies fundamentally on multiple instantiations. Recordings are only

placeholders for the works, but not the pieces in their aesthetic purpose. This is a clear example of Emmerson's borderline case of liveness.

My approach is inspired by Xenakis' message regarding statistical works: multiple versions must be experienced for truly stochastic music. Limited by technology, Xenakis had to create canonical examples of works that otherwise would be ideally realised multiple times. These fixed-medium works, though created by indeterminate processes, are no more or less live than other electroacoustic, fixed-medium works. Their liveness relies on Emmerson's 'living presence'.

But, Xenakis' work shows that real-time works are not the only way to make indeterminate music live. Pieces such as *Pithoprakta* (1956) and *Syrmos* (1959), among others, are early instances of CAC. The processes themselves are not created in real-time, and these indeterminate works were actually translated into standard musical notation for human performance. The materials may be constructed offline and the indeterminate processes fixed, but the performances are as live as any acoustic, notated work.

So it seems, though indeterminate processes can now be realised in real-time and potentially live, they are not clearly so.

Recorded versus Live

When it comes to electroacoustic music, what is recorded versus live becomes increasingly complex. A very interesting case is when older works created for analogue technology are translated to the real-time digital domain. Puckette (2001) translated four works into real-time digital versions, but the works he translated were already considered live. They were works that in their original forms used live performers (though the electronics involved could be live or recorded).

Burns (2002) realised two early analogue works in real-time, as well. Though his treatment of Stockhausen's *Mikrophonie I* resonates with Puckette's examples, Burns also recreated *I am Sitting in A Room* by Alvin Lucier in real-time. To some, the authentic version of this work is Lucier's original recording in 1970. The original 'score' is a paragraph written by Lucier. In his original instructions, Lucier did not actually refer to a real-time version (Tarantino, n.d.), perhaps due to the technology available in 1969. Later, Lucier included real-time realisations as a potential version of the work (Lucier, 1995 cited in Burns, 2002). At the very least, this undermines the notion that his original recording is the most authentic. Burns' discussion of the realisation opens the door to many interesting insights into Lucier's work. The real-time versions "offer opportunities which can only be implicit in fixed-media versions of the piece. A live realisation tends to increase our sense of wonder at the piece [...]" (p. 61).

Perhaps Burns' most interesting point is that the real-time version makes the piece more live, because, (contradicting the original text) we are no longer sitting in a room 'different to the one you are in now'. Like my own work, each real-time version of *I am Sitting in a Room* is different; it depends on the acoustic factors of the inhabited space. The very make-up of the audience is a living presence in the work. Yet, the real-time version is a process that runs with practically no *intentional* human interaction.

Notated versus Improvised

If liveness in acoustic music can be qualified by spontaneity, living presence, indeterminate influences, risk of failure, acceptance of error, listener experience, etc., then this implies that improvised music could be more live than notated music. This implication is maintained in the case of electroacoustic music.

One example is Manoury's recent work, *Tensio* (2010). In this work, a notated string quartet interacts with real-time computer processes to create material. The string quartet part is composed and notated precisely, allowing for no changes beyond small normative interpretations. The computer, however, has a variety of different roles. Although the synthesised sounds are all generated in real-time, the structure, pitches, gestures, etc., of the sounds come from a variety of indeterminate and determinate procedures (Manoury, 2013). On the one hand, there are nearly-recorded passages where timbres are generated live; on the other hand, there are completely live, indeterminate procedures within highly limiting parameters. On a straightforward glance, the inclusion of live performers would situate this work as live, but it is unclear how live the real-time computer material is.

In comparison, in radical opposition both musically and philosophically, Lewis' work *Voyager* (1987) is completely improvised by both a human and a computer performer. Both the human and computer performers listen, respond and can initiate new material. As a freely improvised work, a recording is not representative of the piece. Furthermore, the computer is an additional living presence.

Between these two extremes could be Rowe's *Maritime* (1992). Two-thirds of the work is notated and one-third is improvised. It also requires a human violinist to interact with the work, but there are moments when the computer has its 'own personality' (Rowe, 1999, p. 86). So, like Manoury and Lewis, this work is live. But it could be argued that it resides between the two pieces in degrees of liveness, if it could be argued that improvised music is more live than notated music and that computer autonomy also factors in liveness.

If computer autonomy is a generator for living presence through the notion of computer performer, then the discussion must revisit real-time computer music that does not require a human performer. In that case, like my own works, the computer not only has autonomy, it is the only performer in the work. So, what kind of real-time material engenders the role of computer as performer? There may be no prescriptive answer.

Manoury, Rowe and Lewis illuminate shades of liveness through the subtle distinctions of notated versus improvised material. But, there is another improvised genre that problematizes this discussion: laptop performance. In this case, unlike these others, the human performer is not using a traditional instrument and the computer is not a performer. Rather, the computer is the instrument. Like anyone performing on an instrument, material can be composed and decided in advance or improvised extemporaneously. Almost all material generated by the laptop is happening in real-time, but there could also be recorded material that is triggered at liberty.

³ Perhaps a discussion for another arena would be how improvised performances of non-traditional scores, such as graphic scores, are compared to traditional scores. It would have to include performance practices of early music, where a great deal of the music was extemporaneous, using only the notation as a guideline, compared to the hyper-prescribed scores of the 19th and 20th centuries. In that discussion, Puckette's realisation of *Mantra* by Stockhausen, a clearly notated score, and Burns' realisation of *Mikrophonie I*, a precise albeit graphic score, raise questions. This discussion could have ramifications for what is considered more or less live in live electronic works.

Collins' (2003) description of the human interactions in live laptop performance can look rather similar to real-time computer music without human intervention, because audiences cannot relate the minimal physical gestures to the resulting music. At some basic level, audiences participating in live laptop performances know that it is live, even if human contribution is impenetrable. The audience may also assume that the material can be indeterminate and/or improvised. So, liveness in laptop performances is more an audience construct, not derived from the creation of the music itself.

Liveness Spectrum

The discussions of liveness and real-time music with these particular musical examples raise more questions than answers. In problematic distinctions, this may be more desirable than quantitative, definitive labels. Therefore, it is rather more interesting to compare examples and determine relative degrees of liveness. This paper proposes the following scales as a starting point for considering liveness.

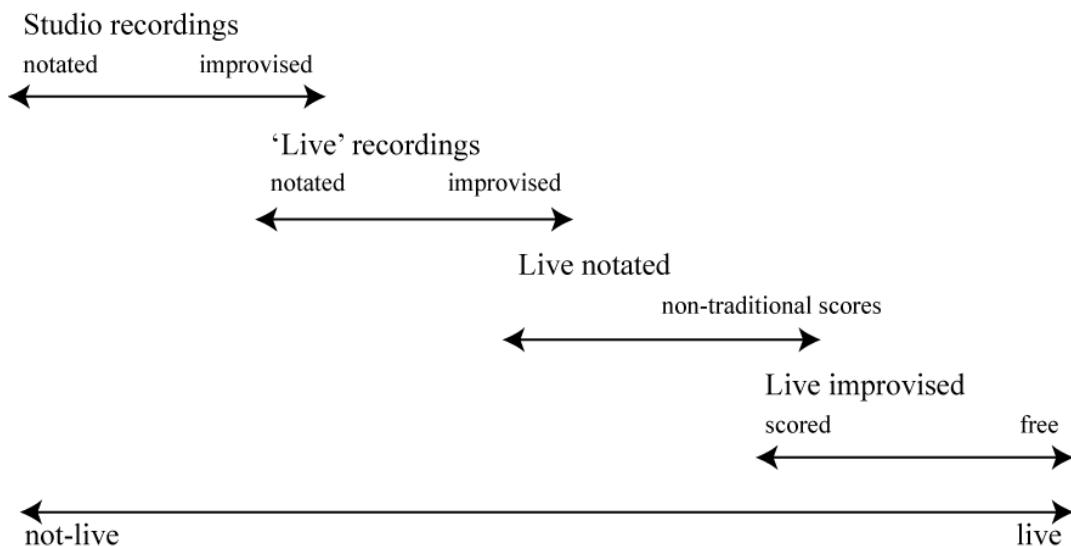


Figure 1. Liveness of acoustic music

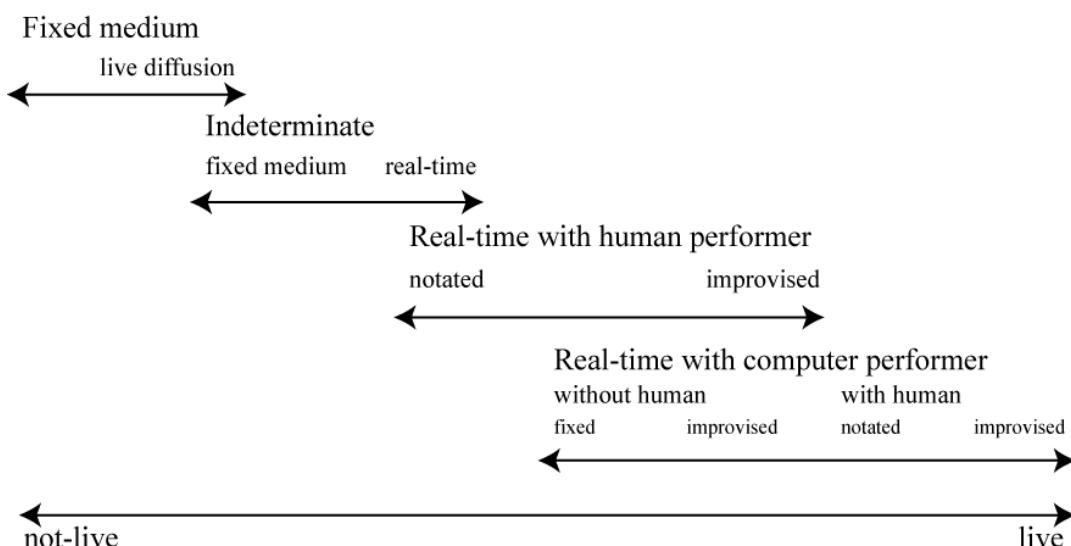


Figure 2: Liveness of electroacoustic music

These scales are by no means definitive. Boundary cases overlap, and some examples can be located in multiple spaces. The spectrum serves only as a springboard for debate.

Conclusion

Although there may be an assumption that real-time computer music is live, not all works are the same. Although human interaction may determine liveness, not all human interaction is created equal. Boundaries between types of music are blurry, and a number of works live in those boundaries. All of this suggests that liveness is a spectrum. Given this, liveness should be identified as a relative feature, not absolute. Real-time computer music is just another method to generate musical material, and as such, does not necessarily guarantee the liveness of a work. How live is real-time? It depends.

References

- AGOSTINI Andrea, GHISI Daniele, “Real-Time Computer-Aided Composition with *bach*”, *Contemporary Music Review*, 32(1), 2013, pp. 41-48.
- BURNS Christopher, “Realizing Lucier and Stockhausen: Case Studies in the Performance Practice of Electroacoustic Music”, *Journal of New Music Research*, 31(1), 2002, pp. 59-68.
- COLLINS Nick, “Generative Music and Laptop Performance”, *Contemporary Music Review*, 22(3), 2003, pp. 67-79.
- EMMERSON Simon, *Living Electronic Music*, Hampshire, Ashgate Publishing Ltd., 2007.
- GARNETT Guy E., “The Aesthetics of Interactive Computer Music”, *Computer Music Journal: Aesthetics in Computer Music*, 25(1), 2001, pp. 21-33.
- HAGAN Kerry L., “Textural Composition: Implementation of an Intermediary Aesthetic”, *Proceedings of the International Computer Music Conference*, Belfast, Northern Ireland, 2008, pp. 509-514.
- HAGAN Kerry L., “The Noise of *Morphons and Bions*”, *Proceedings of the International Computer Music Conference*, Perth, Australia, 2013, pp. 376-379.
- LEWIS George E, “Too Many Notes: Computers, Complexity and Culture in *Voyager*”, *Leonardo Music Journal: Southern Cones: Music Out of Africa and South America*, 10, 2000, pp. 33-39.
- MANOURY Philippe, “Compositional Procedures in *Tensio*”, *Contemporary Music Review*, 32(1), 2013, pp. 61-97.
- PUCKETTE Miller, “New Public-Domain Realizations of Standard Pieces for Instruments and Live Electronics”, *Proceedings of the International Computer Music Conference*, San Francisco, USA, 2001, pp. 377-380.
- PUCKETTE Miller, “A divide between ‘compositional’ and ‘performative’ aspects of Pd”, Paper presented at First Pd Convention, Graz, Austria, 2004.
- ROWE Robert, “The Aesthetics of Interactive Music Systems”, *Contemporary Music Review* 18(3), 1999, pp. 83-87.
- SELEBORG Carl, *Interaction temps-réel/temps différé*, mémoire ATIAM, Marseille, 2004.

TARANTINO Todd, “Alvin Lucier: I am Sitting in a Room (1969)”,
http://toddtarantino.com/hum/lucier_iamsitting.html (last accessed 05/14).

XENAKIS Iannis, *Formalized Music: Thought and Mathematics in Composition*, (rev. ed.),
“Harmonologia Series no. 6”, New York, Pendragon Press, 1992.

Musical Works

HAGAN Kerry L., *real-time tape music III*, 2008.

HAGAN Kerry L., *Morphons and Bions*, 2011.

LEWIS George, *Voyager*, 1987.

LUCIER Alvin, *I am Sitting in a Room*, 1969/1995.

MANOURY Philippe, *Tensio*, 2010.

ROWE Robert, *Maritime*, 1992.

STOCKHAUSEN Karlheinz, *Mikrophonie I*, 1964.

STOCKHAUSEN Karlheinz, *Mantra*, 1970.

XENAKIS, Iannis, *Pithoprakta*, 1956.

XENAKIS, Iannis, *Syrmos*, 1959.