

# The Intersection of ‘Live’ and ‘Real-time’

KERRY L. HAGAN

Digital Media and Arts Research Centre, Department of Computer Science and Information Systems, CS1025, University of Limerick, Limerick, Ireland  
Email: Kerry.Hagan@ul.ie

**Real-time computer music is now common and ubiquitous, no longer a new or experimental practice. In its infancy, it helped to solve perceived issues with the fixity of tape pieces, a natural continuation in the practice of live electronics. However, real-time computer music did not have the same consequences as live electronic music. This situation engendered many discussions about the liveness of real-time computer music performances at the time. It is now 20 years past those first conversations, and it is important to revisit what is ‘live’ and how it applies to real-time musics. Additionally, in some ways, the language surrounding descriptions of fixed medium works, mixed works, live electronics and real-time computer music has evolved and, perhaps, even settled into conventions distinguishing musical approach and philosophies. This article first defines the language, not to proselytise, but rather to ground the argument. The conclusion asserts that liveness is a spectrum despite the fact that ‘live’ is often used categorically. Though one may have an intuitive understanding of what constitutes a ‘live’ event, this article explicitly articulates the most significantly contributive factors. The nature of real-time computer music is explored in relation to these factors of liveness. Using musical examples, this article shows that ‘real-time’ music does not guarantee a ‘live’ performance, contrary to what is typically held to be true. Instead, ‘real-time’ simply becomes a descriptor of compositional method, and any real-time work can exist along a broad range of the liveness spectrum.**

## 1. INTRODUCTION

As with any naturally evolving language, the terminology describing different ways of making music through any electronic or digital mediation has shifted over time. Composers and musicologists use contrary phrases to mean the same thing or the same words to mean divergent ideas. Therefore, any discussion around ‘live’ music and ‘real-time’ music becomes entangled in a briar patch of crossed meanings, subtle distinctions and, of course, shorthands for aesthetic principles. Perhaps this entanglement is as much a product of language as it is of philosophy when discussions around live music and real-time music arise.

Although Simon Emmerson has discussed liveness more generally in *Living Electronic Music* (2007), liveness and real-time computer music was only examined 20 years ago. In 1994, Emmerson specifically discussed “‘Live’ versus ‘real-time’” (Emmerson 1994). In 1999,

Marco Stroppa asked, ‘Live electronics or ... live music?’ (Stroppa 1999). These two articles looked closely at what the relatively new technology allowing real-time computation meant for music. Twenty years later, this technology exists so pervasively, it is taken rather as a matter of course than a particularly special occasion. Not only that, but contemporary technology is affordable to most musicians around the world, making it even more ubiquitous. Consequently, what it means to be ‘live’ or ‘real-time’ depends on different factors today. Therefore, it seems apt to feature where these ideas currently intersect. This article starts by laying out definitions for commonly used words – ‘liveness’, ‘real-time’, ‘live electronics’ and ‘interactive’ – in the context of electroacoustic music.<sup>1</sup> By no means is this meant to be exhaustive, definitive or evangelical; it is simply a way to clarify the domains at hand.

In this endeavour, it becomes clear that ‘liveness’ is not a categorical state, so the definition becomes one of relative characteristics. ‘Real-time’ may be more categorically precise, but not necessarily so. Additionally, it must be extricated from ‘live electronic’ and ‘interactive music’, terms that may be used interchangeably depending on the musical viewpoint of the observer. Musical examples better demonstrate the taxonomy of these practices. So, this article compares works with different compositional tenets to further establish useful meanings in the language. Newer forms of real-time computer music-making, such as live coding and laptop performances, are situated in the liveness spectrum as well.

Ultimately, we find that the crossroads of ‘live’ and ‘real-time’ is a fluid intersection without categorical distinctions. When discussing live performances and real-time computer music, we are better served to relate works on a spectrum, finding the kernels of aesthetic differences in much more blurry and, I believe, interesting variations.

## 2. NOMENCLATURE

Four phrases are explored here: ‘liveness’, ‘real-time’, ‘live electronics’ and ‘interactive music’. Comparing

<sup>1</sup>Electroacoustic music used here signifies any music that relies on, in part or whole, electromechanical or digital means of production.

different musicians' uses of these words gives rise to loci of meaning, if not explicit definitions. From these positions, specific musical works can populate a spectrum of traits.

### 2.1. 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 complex 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 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, scores with indeterminate procedures, 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.

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 multidimensional space of liveness.

Stroppa only lists two conditions for a performance to be experienced as 'live'. The first is the presence of a human performer, but equally important, they must be playing an instrument 'that is accepted as such by the musical community' (Stroppa 1999: 50). He points out that a live performer on a stage working a mixer would not be as live for an audience as a performer on a traditional instrument. Yet, there is a growing audience who recognise equally impenetrable laptop performances or no-input mixer ensembles as live. This may be the acceptance of technology after 16 years as bona fide instruments, or it could be due to other factors discussed later.

Emmerson (2007) wrote comprehensively on what makes electroacoustic music 'live'. He problematises shades of difference, arguing quite convincingly that even fixed medium works create a living presence through human reception in contradiction to Stroppa. In his discussion, he acknowledges tricky 'borderline' cases, one of which is the example of machine-generated music without human interaction. In this article, 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.

The range of recording contexts (studio versus live) and the multiple generative/interpretive strategies (from score to improvisation) uncover other aspects of what one considers when thinking of live music: spontaneity, indeterminate influences, risk of failure and acceptance of error, as well as the living presence and audience experience. There are likely many more unconscious or smaller factors, but these rank among the most significant. Though individual listeners may rate the musical encounters differently, these factors clearly transcribe a multidimensional space conferring liveness.

In summary, liveness is attributed by:

- spontaneity – where musical decisions, from minor interpretive differences to larger formal choices, are made;
- risk of failure – some musical gambits may not be entirely successful or convincing and errors can be made;
- an acceptance of error and fault – mistakes, failures, errors and other unwanted consequences cannot be 'cut out' before the audience receives them, a condition that is accepted if not necessarily welcomed;
- audience/performer contract – the performer or composer asserts liveness and the audience agrees to the assertion, impacting the audience experience;
- indeterminacy – this may be a compositional decision, but it is also a result of spontaneity, risk and error;
- living presence – a complicated combination of agency, action and human reception thoroughly examined and defined by Emmerson (2007);
- audience experience – though also significantly impacted by the audience contract, this includes the social and psychological conditions of attending a performance.

### 2.2. Real-time

Nearly every discussion of real-time defines it as a binary. 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 article argues, through these definitions, that real-time is a complicated scale, not a categorical qualification.

Miller Puckette 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’ (Puckette 2004). The performative seems to rely on human input or triggers, as well. Yet, composed elements often trigger real-time processes.<sup>2</sup> The boundary between compositional and performative is not clearly distinguishable as non-real-time or real-time.

Carl Seleborg 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 (Seleborg 2004). CAC is traditionally considered to be a 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, Andrea Agostini and Daniele Ghisi 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 and their terms, to be a source of CAC, resulting in human-readable scores. Agostini and Ghisi refer to traditional CAC as ‘speculative’ (Agostini and Ghisi 2013). 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. Nick Collins is careful to use ‘generative music’ for the materials used in real-time laptop performance, although he occasionally refers to algorithmic composition (Collins 2003). 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. An educated audience would have a different contract with the performer and a different experience from a naïve audience. Collins 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. This suggests that live laptop performance, including live coding, can display varying degrees of real-time processes. In his discussion, Collins 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).

Guy Garnett 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 subgenre 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. (Garnett 2001: 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 diffusion 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. Though interactivity here is a circumstance of real-time, it requires more discussion. An elaboration follows in section 2.4.

Similar to Garnett, Robert Rowe asserts that interactivity assures liveness, that ‘the musical values evinced in interactive compositions are ultimately the same as those underlying a string quartet’ (Rowe 1999: 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. Whether or not that artificial presence is sophisticated, if the audience perceives an agent with will, then a living presence emerges.

<sup>2</sup>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.

Perhaps, then, an extreme version of this concept can be found with George Lewis. In his work, the computer-as-performer is elevated to the equivalent status of the human performer. He argues that this multidominant approach exists outside the pan-European experimental ethos (Lewis 2000). 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. In section 3, concrete musical examples will differentiate these concepts and how they operate in the discourse.

### 2.3. Live electronics

In the first uses of the phrase 'live electronics', composers referred to analogue circuits that synthesised or modified sounds immediately. This stood in stark contrast to the studio composition on fixed media. Even in the earliest days of computer music, compositions had to be coded, compiled, run and recorded, so there was no more liveness to computer music than tape music.<sup>3</sup> However, digital audio technologies developed at an astounding rate. Though computers took some time before they could process sound in real time, dedicated digital hardware designed for specific purposes (e.g. reverb, filters, oscillators) fell into the category of live electronics, most likely because they functioned as black boxes much like analogue components. The crucial distinction was that these devices operated in real time. However, 'real-time' as an adjective appeared only when computers became fast enough to behave like live electronics and probably as a consequence of computer science concerns. This may account for early ambiguity in applying 'live electronics' or 'real-time' to a performance. At least, this may be true for Anglophones, as the French used *temps réel* in studio contexts (Emmerson 2007).

In 1991, Barry Schrader asserted that audiences struggled with performances of tape music because it

<sup>3</sup>In fact, in the early days of computer music, the sounds seemed quite lifeless compared to the musique concrète sounds of real life.

had no performer. He identified live electronics as the first solution to this unease (Schrader 1991). Therefore, another aspect of 'live electronics' implies there is a human performer of an instrument or otherwise. Real-time computer music is agnostic on that account. Emmerson's definition of 'live electronics' requires a live performer, whether on electronic or acoustic instruments, but also more inclusively someone 'who may cause, form or influence [the sound] through electronically mediated interfaces under their immediate control' (Emmerson 2007: 90). This does not fix the issue, either, as Emmerson is quick to point out borderline cases that prove the rule.

In my experience today, people reserve 'live electronics' to refer to devices or systems that synthesise or process sounds in real time but do *not* qualify as stand-alone computers. The language may or may not be sorting itself out. However, this means that there are musical practices descending from compositional uses for live electronics that result in significantly different approaches to those practices descending from computer music, even if eventually all works get ported to computer software. So what to make of the computer re-creations of analogue electronic works, such as Christopher Burns's (2002) import of Stockhausen's *Mikrophonie I*, or Miller Puckette's Pd Repertory Project (2001)? The easy, yet somewhat assailable, answer is that today's audiences do not see a computer on a stage and call it 'live electronics' regardless of ancestry or human presence. So, live electronics do not factor into the discussion of liveness in real-time computer music.

### 2.4. Interactive music

Depending on a musician's purpose, 'interactive' can be quite broad or quite narrow. Garnett defines interactive as works 'wherein the performer in some way controls the electronics or the electronics affect the performer's sounds' (Garnett 2001: 21). In this definition, control can flow in one of either direction: performer to electronics or electronics to performer. But, some musicians seem to prefer when control flows in both directions. Philippe Manoury singles out Arshia Cont's innovations with *Antescofo* (2007) that 'allow a fluidity of "dominance", between musician and computer: each may, at a given moment, listen and respond to the other' (Manoury 2013: 85). Lewis and Rowe both created pieces where the computer's role was increasingly dominant even before Cont's software (Rowe 1999; Lewis 2000).

The first efforts to integrate live performers with tape music might have allayed audience's needs for human stage presence, but the performers themselves had mixed opinions about performing with immutable accompaniment. Perhaps more commonly, performers agree with Elizabeth McNutt, a veteran performer



of flute and electroacoustic music. She puts it eloquently:

For the player, performing with fixed accompaniment is like working with the worst human accompanist imaginable: inconsiderate, inflexible, unresponsive and utterly deaf. While the performer commands the audience's attention, she is in an ironically submissive relationship to her chamber music partner, focusing most of her attention on coordination with her accompanist – since he has full responsibility for keeping the ensemble together! (McNutt 2003: 299)

At the same time, Stroppa felt that his performance of *Kontakte* by Stockhausen (for percussionist, pianist and 4-channel tape) was as nuanced as any acoustic ensemble work, despite McNutt's and others' criticism of tape's rigidity (Stroppa 1999: 43). However, McNutt's opinion seems to be representative of the majority of performers' experiences, and interactive electronics are the solution.

The main qualifying distinction here is that at least one component has an effect on another, and the degree of interactivity relies on the degree to which both components affect each other. Therefore, this can be applied to live electronics or real-time computer music; it is a separate territory.

### 3. CASE STUDIES

In effect, there are really four broad descriptors in 'live', 'real-time', 'live electronics' and 'interactive'. Liveness depends on situational factors. Real-time is a computer method. Live electronics refers to music-making without a computer but with electronic means. And, interactive indicates that any electronic means can be affected by a human agent. In fact, such interaction can be bi-directional. Any combination of the four can be true about a given work. The salience of each descriptor is better suited to what the work itself is setting out to do. This article is most interested, however, in where 'live' and 'real-time' intersect. The following musical examples focus on this and leave the discussion of live electronics and interactivity to another day, although they are not irrelevant.

Some meta-dialectics and binaries 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, even 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 binary, recorded versus real-time generation, seems a good distinction to use with real-time computer music. However, elements of recorded passages can exist in real-time performances, so this distinction is non-trivial.

#### 3.1. Determinate vs 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. This accommodates Iannis Xenakis's message regarding statistical works: multiple versions must be experienced for truly stochastic music (Xenakis 1992). 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 Emerson's 'living presence'. However, Peter Hoffmann re-programmed the Gendyn system created by Xenakis, allowing for one such work, *Gendy3*, to be realised in real-time (Hoffmann 2000). Thus, Xenakis's original intention for multiple versions can be realised for an audience in real-time.

But, Xenakis's 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. In fact, some indeterminate works by Boulez or Stockhausen may be more 'live' because they require real-time decision making for acoustic, notated scores.

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

#### 3.2. Recorded vs real-time generation

When it comes to electroacoustic music, what is recorded versus live becomes increasingly complex. Of particular interest are older works created for analogue technology that 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 (see Pd Repertory Project 2007). They were works that in their original forms used live

performers (though the electronics involved could be live or recorded).

Burns 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 (Burns 2002). 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 nd), perhaps due to the technology available in 1969. Later, Lucier included real-time realisations as a potential version of the work (Lucier 1995). At the very least, this undermines the notion that his original recording is the most authentic. Burns's 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 realization tends to increase our sense of wonder at the piece' (Burns 2002: 61). He asserts that Nicolas Collins's argument for the necessity of the tape version is weakened by this experience, despite its value in bringing a private space into a public space (Collins 1990; Burns 2002).

Perhaps Burns's 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 Hoffmann's recreation of *Gendy3*, 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. This version feels more live than Hoffmann's *Gendy3*, though. Yet, the real-time version is a process that runs with practically no intentional human interaction, just like *Gendy3*. In many ways, the real-time version of *I Am Sitting in a Room* includes factors that make the well-known tape piece more live: risk of failure, indeterminate influences, a living presence and a different audience contract with the performer/composer. *Gendy3* does not have the audience contract, the indeterminacy is less living, and the risk of failure may be smaller.

### 3.3. Notated vs improvised

If liveness in acoustic music can be qualified by spontaneity, living presence, indeterminate influences, risk of failure, acceptance of error, audience experience and so on, 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 and so on 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's work *Voyager* (1987 [1993]) 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: 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, the computer not only has autonomy, but is also 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. However, the conditions that lead to whether a computer becomes a performer rely on the audience/performer contract. If the audience is willing to believe that the computer is more than an instrument, in fact the agent with will, the same real-time material becomes more live. If the computer performed a solo version of *Voyager*, or if it was creating a real-time version of *Gendy3*, the comparative liveness of the two pieces ultimately resides with the experience of the listener.

Manoury, Rowe and Lewis illuminate shades of liveness through the subtle distinctions of notated versus improvised material. But, there is another improvised genre that problematises 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.

Collins's 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. In the case of live-coding concerts, where the human action is made visible or understood by the educated audience, the experience itself may be more live. 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. At the same time, there is risk associated with improvisation; Collins points out that 'in the design of interactive system [*sic*] for performance the trade-off between improvisation/adaptability and preparation/quality/seamlessness must be confronted. Risk taking can be made an important part of the work, or the work will demonstrate measured pre-composition' (Collins 2003: 71) This consideration enforces the audience's acceptance of the liveness of a laptop performance.

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 article proposes the following scales as a starting point.

First, liveness in acoustic music spans the range from studio recording to a live, improvised concert performance (see Figure 1).

Liveness of electroacoustic music also spans a range, where real-time computer music exists in many degrees of liveness (see Figure 2).

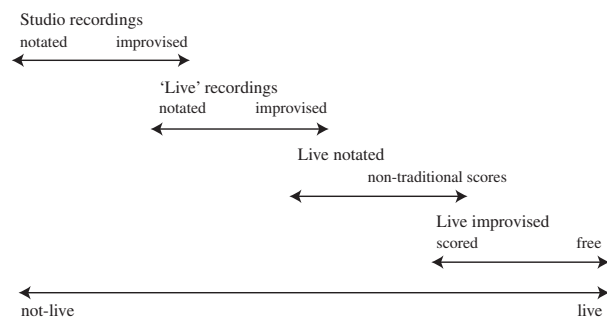


Figure 1. Liveness of acoustic music.

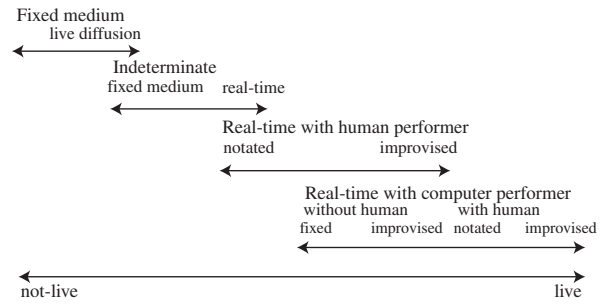


Figure 2. Liveness of electroacoustic music.

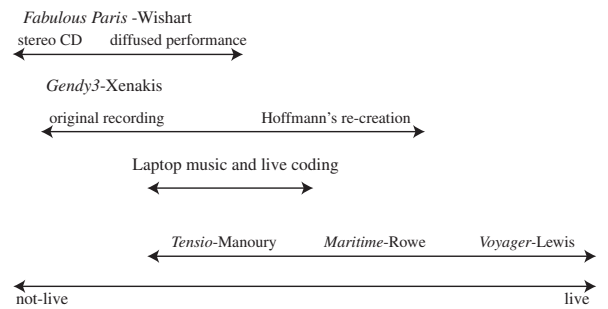


Figure 3. Comparative liveness of musical examples and its problems. Where does the real-time version of *Gendy3* belong?

Given these axes, one could potentially situate the examples here as shown in Figure 3.

These scales are by no means definitive. Boundary cases overlap, and some examples can be located in multiple spaces, especially given the ephemeral nature of the audience's experience. The spectrum serves only as a springboard for debate.

#### 4. CONCLUSION

The first problem this article attacks is the nature of liveness. By articulating liveness as a multidimensional spectrum, all music can exist somewhere on the axis. It becomes apparent that it is far more productive to ascribe liveness than to categorically attribute live/not-live. Liveness depends on spontaneity, risk of failure, an acceptance of error or fault, an agreement between the audience and performer or composer, indeterminacy, Emerson's living presence and the audience experience. In other words, liveness arises from conditions of performance that lead to a human factor, whether as a performer, composer or audience contribution.

The immediately obvious solution for liveness is to involve the human in a transparent aspect of the music-making. Yet, the human can be introduced at many points in the process of composition, performance and reception. Therefore, while it may be easiest to have the human involved as performer, it is not the only way of

ensuring a living presence. Emmerson provides enough argument that fixed-medium pieces can have a living presence. Even performers accustomed to playing with fixed-medium accompanists do not agree entirely on the lack of nuanced, live performance available.

Real-time computer music was seen as a potential solution to the fixity and inhuman perception of taped electronic music. But, the past 20 years have shown that it is not a foregone outcome. Ultimately, the problem is that liveness depends on more than something being created in real-time. A real-time composition may not have the spontaneity or risk, or it may not have the contract with the audience. If it is simply enough to press a button to create the sounds, will it be perceived as live? If the performer is typing on a laptop, the audience must agree that she is somehow making the piece in meaningful ways, not just simply pressing a button then reading her email.

Real-time computer music does bring one new question to the table, however. It lives on an edge that depends on the audience/performer contract, an edge that does not exist in other electroacoustic music. What happens when the audience perceives agency on the part of the computer realising a composition? Can the computer alone impart a sense of agency sufficient to make an audience experience the work as 'live'? This is an interesting notion to consider, though what a composer can do to affect audience reception is fraught with complicating issues beyond the scope of this article. In any case, if the computer is anthropomorphised, then a real-time computer piece can be very live. Unfortunately, it is usually only with human performers that one imagines a comparative agency on the part of the computer, as in the work of Lewis. It is conceivable that a master could program a computer to make musical decisions in apparently human ways. This may, indeed, make real-time computer music more live. So, the liveness spectrum must account for the possibility.

It is rather tempting to convolve real-time with liveness, especially when attempting to create a spectrum of 'real-time-ness'. However, if one starts with the polar opposites: fixed, unchanging recorded material and creating everything from synthesis to form in real-time, then issues of liveness become somewhat separate. Real-time, in fact, only determines a mode of construction. Though it might be a result of compositional or performative aesthetics, it is merely a descriptor. Simply creating a piece in real-time is not the unequivocal solution to liveness. Thus, 'real-time' and 'live' may intersect or influence the reception of either, but one does not demand the other to be true.

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