

Liveness and Interactivity in Popular Music

1. Summary

This chapter describes and compares four approaches to the creation and use of audio-visual interactive systems for the live performance of popular music. These approaches were identified through a practice-led approach in which the underlying aim was to create a portfolio of work for live performance that demonstrated a high degree of liveness and interactivity. The four approaches were:

- Controller-based interactive-generative tools
- Multi-tool systems for guitar and vocal performance
- Systems controlled by typing the lyrics of a piece
- Systems based on real-world metaphors

Following a review of current issues in the live performance of electronic music, recent theories of liveness and interactivity are discussed. Four aspects of liveness are identified from these theories that form the basis for the comparisons between the four approaches listed above. Other work making use of similar approaches is then reviewed, before a discussion on the use of interactive systems in popular music. After an overview of the practice-led methodology used in the project, the four approaches to creating interactive systems are discussed in detail, with reflections on the level of interactivity and the suitability of each type of system for popular music.

Comparisons between the approaches reveal that systems based on real-world metaphors demonstrated the highest levels of liveness. This approach enabled the system to have a presence in space and time distinct from the human performer (spatio-temporal liveness); to reveal the causes of sounds (corporeal liveness), demonstrate interactivity with the human performer (interactive liveness) and reveal the ideas and creative processes behind the composition (aesthetic liveness). The metaphor approach was also well-suited to popular music while allowing significant levels of interactivity during composition and live performance.

2. Contemporary Issues in Live Performance

The well-documented ‘problem’ in the field of live electronic music performance is that performer gestures do not necessarily correlate to sonic gestures (Fels et al 2002). Unlike traditional instruments, a performer can instigate the loudest of sounds of infinite duration with an imperceptible gesture. As it is well accepted that audiences are generally motivated to seek out the causes of the sounds they hear, this could potentially lead to a lack of engagement with the performance (Emmerson 2007). The removal of traditional performance values through the use of pre-recorded media may also detract from the audience’s perception of liveness (Auslander 2008). Despite arguments that for some audiences, the lack of gestures and the use of mediatized material may not be a problem at all (Bown et al 2014), there is a growing body of work considering live electronic music performance from the audience perspective (Reeves et al 2005). Recent work has explored the impact of understanding how digital systems work on an audience’s

enjoyment of a performance (Bin et al 2016) and has explored strategies for achieving this in the field of interactive audio-visual works (Correia et al 2017).

3. Definitions and Background

3.1. Liveness

The binary distinction as to whether a performance is ‘live’ or ‘not live’ has largely been abandoned in favour of a continuum: liveness (Auslander 2008). Several theories of liveness have been proposed. Sidney Fels and colleagues put forward the concept of ‘transparency’, that relates to the effectiveness of the mapping of gestural input to sonic output (Fels et al 2002). Philip Auslander discusses how the use of mediatized material in live performance reduces liveness by detracting from traditional performance values (Auslander 2008). John Croft distinguishes between ‘procedural’ liveness, in which it is simply true that events are being generated in real time, and ‘aesthetic’ liveness, where perceptibly meaningful performer inputs are mapped to perceptibly meaningful outputs (Croft 2007). This relates to the idea of the ‘technological sublime’, where tools become aesthetic objects in their own right (Demers 2010). Paul Sanden suggests that the overall perception of liveness arises through a network of different aspects of liveness (Sanden 2013). For Sanden, liveness can be broken down into:

- Spatio-temporal liveness: an agent’s presence in time and space
- Liveness of fidelity: how faithful the performance is to its initial version
- Liveness of spontaneity: the degree to which the performance is fixed

- Corporeal liveness: the strength of the link between a sound and its observable cause
- Interactive liveness: the extent by which music arises from interactions between agents
- Virtual liveness: the extent by which liveness is perceived in mediatized material

Sanden's theory is flexible enough to deal with a wide variety of approaches to contemporary live performance, such as those involving the presentation of fixed material and those where human performers are not present in the same physical space as the audience.

3.2. Interactivity

Songwriters and composers are influenced by the tools they use. Rather than exert complete mastery over them, composers exploit the affordances and constraints of the instruments and devices that they work with (Prior 2009). When working with interactive systems, true interactivity can be said to occur when there is a mutually influential relationship (Noble 2009) in which both the human performer and the system demonstrate agency over the music being performed (Emmerson 2007). When the system is afforded significant agency over piece through the relinquishing of control by the composer/performer, it can be said to be 'generative' (Collins 2008). Generative systems may demonstrate agency in real-time performance and/or during the composition process. These types of agency have been termed 'performative agency' and 'memetic agency' respectively (Bown et al 2009).

Allowing the system significant performative agency results in each performance of a work being different. Rather than simply seeking to replicate an idealised version (often the recorded version), unique versions of a work are created in each performance. This sits well with wider ideas of indeterminacy, whereby a piece of music may take on different meanings by different people, or by the same person finding different meanings on repeated listens (Jeongwon and Song 2002). Allowing the system memetic agency during the composition process results in unexpected system behaviors influencing the fixed aspects of the composition (Waite 2016). Both the performative and memetic agency of generative systems can bring considerable advantages to the creative process in terms of developing an artists' idiolect through the disruption of familiar creative patterns (Waite 2014).

3.3. Related Work

Interactive-generative processes are used in mobile apps such as *Bloom* (Opal Limited 2017) where the user instantiates a series of audio-visual objects that interact with one another. Similar processes can be found in generative sequencing tools such as *Push Pong* (Towers 2014), in which step sequencer cursors collide and bounce off one another to create unpredictable results.

In terms of popular music performance featuring live instruments, systems tend to use live audio recording and playback in a highly controlled way to enable multi-timbral performance of fixed compositions. Such systems may also involve the use of score-following techniques to allow for more variation in the backing track that is possible with

standard looping tools. Video recording and playback may be synchronized with the audio recordings in order to reinforce audience understanding and their perception of liveness (Marchini et al 2017).

A more recent development in the live performance of musical material with lyrics is 'live-writing' (Lee and Essl 2017), in which text is projected to the audience as it is typed by the performer. Particular letters, words and the rhythm of the typing can be linked to a variety of musical processes and visual effects. This serves to present the act of writing as a real-time process, like that of singing (Waite 2015).

The use of real-world metaphors, such as masses and springs and particle systems, has been used as a design strategy to facilitate liveness. Real-world objects provide a shared point of understanding for composers, performers and audience (Johnston 2013), whether they are grounded in intuitive, physical behaviors or draw on well-known cultural links (Waite 2016).

3.4. Use of Interactive Systems in Popular Music

The use of interactive systems where there is significant agency by the system is not common in popular music. While there are some notable exceptions, such as *Algorave* and *Musebots*, these tend to be limited to blues, jazz and electronic dance music (Bown et al 2015), which allow for more open forms in performance than song-based music. As well as the need to adhere to stricter structures than more improvisatory forms (Marchini et al 2017), there may also be a pressure to reproduce an idealised recording (Cascone 2002) and therefore minimize risk (Kirn 2012).

There is also a danger that popular music audiences, so used to the playback of audio and video recordings during live performance, may think that the output of an interactive system is actually a fixed backing track. This perception can be so strong that it can persist even when they are told by the performer that the system is live (Biles 2013). Performing with generative systems that demonstrate a high degree of liveness while adhering to the conventions of popular, song-based music is therefore a significant challenge.

4. Method and Methodology

This study is an example of practice-led research (Nelson 2013). Detailed journals were kept during the composition and rehearsal of the pieces, and following public performances. The four approaches arose during the course of the practice, rather than being established at the start. All of the approaches feature significant levels of system agency and a minimum of pre-recorded material, meaning that each performance would be a unique event, with no single idealised version of the work. However, certain structural elements of the compositions were retained in order that they could be identified over repeated performances.

Four types of liveness were then selected to compare the four approaches. These were chosen to incorporate aspects of Sanden's (2013) and Croft's (2007) theories that relate to the live performance of popular music. The four types were:

- Does the system have a presence in time and space? (Temporal-spatial liveness)
- Does the system reveal how it is creating sounds? (Corporeal liveness)

- Is the interaction between human performer and the system evident? (Interactive liveness)
- Is the system's audio-visual output related to the aesthetics of the piece? (Aesthetic liveness)

The systems were realized in *Max* (Cycling '74 2014) and *Max for Live* (Ableton 2013). *Max* allows for rapid prototyping of ideas, while *Max for Live* facilitates the creative process by allowing easy access to transport, routing, audio and software instruments in *Live* (Ableton 2014). *Processing* (Reas & Fry 2015) was also used for some of the system visuals. As a well-documented C-like programming language aimed at artists, it offers significant efficiency advantages over graphical programming languages for some tasks.

In terms of hardware, a constraint was imposed that the systems should require minimal additional hardware. There are several advantages to this, including minimal additional learning, rehearsal and performance demands on the performer; lower costs; ease of setup and portability (Richards 2006).

5. Discussion of Approaches and Compositions

5.1. Interactive-Generative Tool: *Rows, Columns, Collisions* (2012)

The first approach involved creating a complex sequencing tool, with a Novation Launchpad as its user interface. The system's visual outputs, which mirror the behavior of the Launchpad, are shown in Figure 1. The functionality of the tool is as follows:

- Pulses moving horizontally across the Launchpad (red squares) are able to create MIDI events themselves and/or act as a playback cursor for a step sequencer, colliding with user-activated squares (small, solid, yellow squares) to create MIDI events (large, hollow, yellow squares).
- Pulses moving vertically across the Launchpad (green squares) could modulate the behavior of the horizontal pulses, create MIDI continuous controller data and / or act as a playback cursor for a step sequencer in the same way as above.
- When horizontal and vertical pulses collide (large, hollow, white squares), further MIDI events are generated.

Because the speed and direction of each pulse can be set independently, the system's behavior is highly complex. Therefore, while the system is fully under the performer's control, its output is unpredictable and can be considered generative.

The system visuals were designed to highlight the workings of the system to the audience in ways that were not possible on the Launchpad. For example, the motion of the green squares can be set to move gradually rather than in discrete steps in order to represent continuous modulation. Performer actions and collisions were highlighted using additional colors and shapes.

While the system has been used to create and perform an experimental piece of music (National Trevor 2012), the system has also been used in a popular music context (National Trevor 2014c). However, this piece involves significantly greater use of pre-

sequenced material as opposed to individual note events, which may risk detracting from the overall liveness.

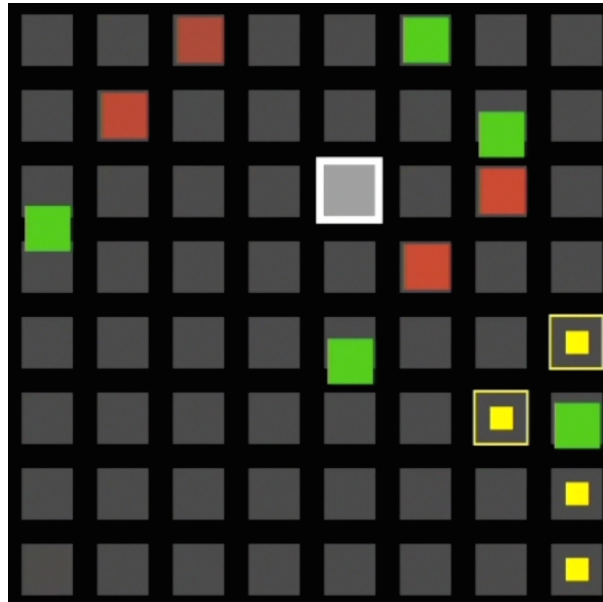


Figure 1: System visuals for *Rows, Columns, Collisions*

5.2. Tool-Led Guitar and Vocal: *Willow* (2014)

The second approach represents an attempt to use interactive systems in a more traditional vocal and guitar performance context (National Trevor 2014b). A suite of devices was created to augment the live guitar performance, including loopers, granular synthesizers, probability-based rhythm generators and spectral processors. These were controlled by real-time performance data from the guitar signal and a mounted accelerometer. A score-following system was implemented in order to modify the behavior of the devices according to the song section.

The system visuals in Figure 2 were designed to reveal the system's behavior in terms of inputs, processing and outputs. The sliders at the top show the real-time performance data with the text box in the top right displaying the current song section. The top three and bottom left boxes represent the looping devices. The bottom central and right boxes represent the outputs of the granular synthesizer and spectral effects respectively.

While the system was successful in that it could reliably augment the human performance of a fairly traditional song, the system's agency was limited in terms of shaping the composition or performance. A further weakness was the system's visual output. The solution shown in Figure 2. is simply an abstracted version of the software itself, that functions primarily as a visual interface for the performer rather than significantly facilitating audience understanding of the system or contributing to the aesthetics of the piece.

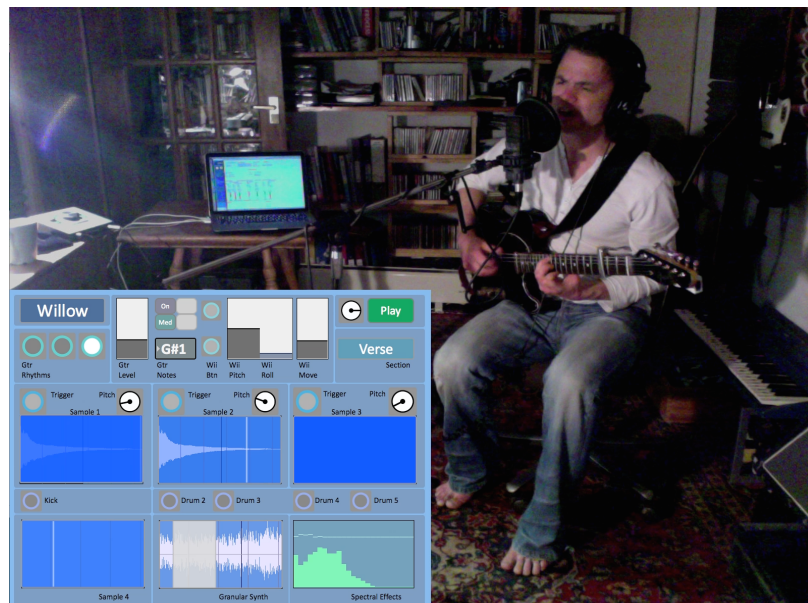


Figure 2: Studio performance of *Willow* showing performer and system visuals

5.3. Typing Systems: *Kafka-Esque* (2014)

The development of typing systems was a response to the observation that the lyrics of songs are often difficult to follow in the live performance of popular music, particularly when the material is unfamiliar to an audience. Several aspects of a popular music performance compete for attention, such as vocal ability, instrumental ability, physical presence and the presence of system visuals. In *Kafka-Esque* (National Trevor 2014a), typing replaces singing. To reinforce this comparison, samples of sung syllables are triggered to match the sounds of the words being typed, and there is no delete function. Letters are projected to the audience as they are typed, putting the lyrics at the center of the performance (see Figure 3).



Figure 3: Studio performance of *Kafka-Esque* showing performer and system visuals

A further aspect of the piece is the exploration of the musicality of typing gestures. There are strong links between QWERTY keyboards and musical instruments, and daily use of the keyboard results in a degree of virtuosity (Waite 2015). The use of the keyboard as an input device also satisfies the research criteria of minimal additional hardware. Typing gestures were linked to rhythm capture, generative melody generation and score following which controlled visual effects. Further interactivity was achieved through a feedback loop between the visuals and synthesizer timbres.

Due to its rhythmic ambiguity and the foregrounding of unpredictable, generative processes, *Kafka-Esque* cannot truly be described as popular music. However, it does feature the live performance of composed lyrics, and makes use of fixed structures. In the near addition, the system could be adapted for compositions featuring a clear pulse and foregrounded melodic motifs.

5.4. Metaphor Systems: *Church Belles* (2015) and *Piece for Tape* (2017)

The fourth approach marked a second return to guitar and vocal performance. Instead of creating multiple tools, the system was built around a single audio-visual metaphor. As well as facilitating liveness by providing a shared point of understanding for the composer/performer and the audience, the metaphor suggests intuitive possibilities for the system's audio and visual outputs and for how these could be mapped to the live guitar and vocal. By introducing the metaphor at an early stage in the compositional process, the metaphor can be poetic as well as functional and be embedded in the song's themes.

Two pieces were composed using this approach. In *Church Belles* (National Trevor 2015), ten virtual bells (see Figure 4) were created in Max, which ring in response to specific notes being played on the guitar, as detected by signal analysis software (Jam Origin 2017). The force with which the bells ring is determined by the detected velocity of the guitar note. As well as producing a bell sound, each strike of the bell's clapper against the body pitch shifts the live vocal to create complimentary backing vocal layers.

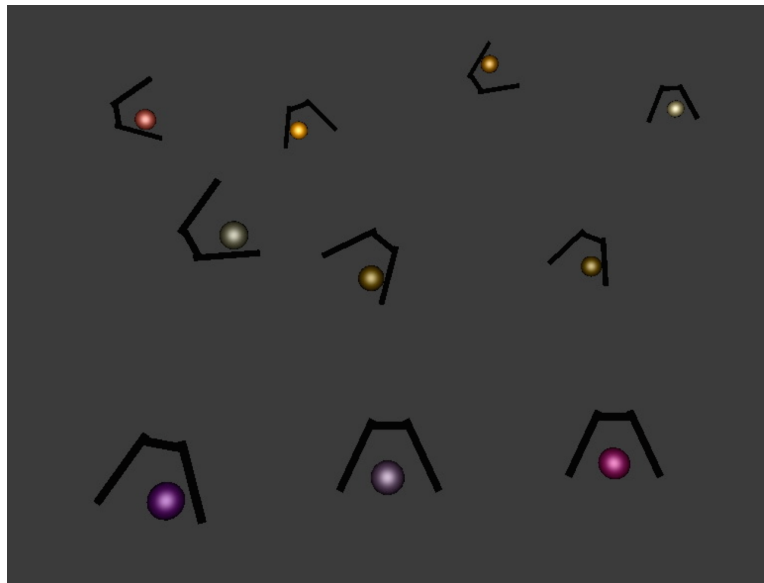


Figure 4: System visuals for *Church Belles*

As in *Willow*, a score-following system was implemented. When the system detects a change in the guitar part, the constraints on the bells' hinges are removed, enabling them to rotate through 360 degrees. At the same time, the strike messages are connected to a synthesizer in addition to the bell sounds. These new behaviors create a shift in the metaphor through a resemblance to air raid sirens. The contrasts and connections between church bells and air raid sirens became a central theme of the piece's lyrics.

Piece for Tape (National Trevor 2017) makes use of the cassette tape as its central metaphor. Each cassette represents an instance of a real-time looper device that records and plays back either the live guitar or vocal (see Figure 5). The stopping and starting of recording and playback is accompanied by the playback of samples of actual cassette players, which creates a percussive layer. Again, a score-following mechanism is used to control the behavior of each looper device at particular sections of the song.

As with *Church Belles*, the memetic agency of the system was significant. The selection of the cassette as the central metaphor influenced the inclusion of nostalgia and non-linear time as central lyrical themes. The system also demonstrates significant performative agency. The behavior and output of the loopers is unpredictable, which, coupled with the reflexive aspects of the system, facilitates improvisation during performance.



Figure 5: System visuals for *Piece for Tape*

Like the interactive-generative tool and the typing systems, the metaphor approach allowed the systems to demonstrate significant agency, thereby fulfilling the need for the systems to be truly interactive. They also allow for the composition and performance of music that can most certainly be identified as ‘popular’, and facilitate the system-building process by suggesting mappings and outputs that are intuitive for both performer and audience.

6. Findings

Following several performances of each of the above pieces, the different approaches to the creation of interactive systems were compared according to how successful they were in terms of the four aspects of liveness identified in section 3. Table 1 shows the results. A cross indicates not at all successful, a tick and a cross indicates partially successful, while a tick indicates very successful.

	Interactive-generative tool	Tool-led guitar and vocal	Typing	Metaphor
Spatio-temporal	✓✗	✓	✓✗	✓
Corporeal	✓	✓✗	✓✗	✓
Interactive	✓✗	✓✗	✓✗	✓
Aesthetic	✗	✗	✓	✓

Table 1: Comparison of approaches in terms of demonstrating aspects of liveness

6.1. Spatio-Temporal Liveness

In terms of spatio-temporal liveness, all systems were at least partially successful through the use of visuals to endow them with a visible presence. The tool-led guitar and vocal and metaphor approaches were deemed more successful as the system exists and functions separately from the human performer. In the interactive-generative tool and typing approaches, the human performer plays on the system rather than with it, meaning that there is less separation. Here, the system can be considered to be more of a generative tool or instrument rather than a co-performer.

6.2. Corporeal Liveness

In terms of corporeal liveness, most of the systems offer clear visual clues to the causes of sonic events. In *Rows*, *Columns*, *Collisions*, each sonic event can be linked to the movement of squares or collisions between them. Linking the brightness of the squares to the volume controls provided further clues. However, when used with more highly mediatized material (e.g. triggering drum loops rather than piano notes), the corporeal liveness would be reduced. Also successful is the metaphor approach, which features intuitive causal links based on shared understanding of familiar, real-world objects. *Willow* and *Kafka-Esque* demonstrate a lower degree of corporeal liveness due to multiple layers of audio being controlled by several simultaneous processes. The attempt to provide visual clues to all of these risked information overload in *Willow*, whilst *Kafka-Esque* avoids this by only providing cues for some of these layers and relying on other aspects of liveness to engage the audience.

All of the pieces composed with the systems begin simply and gradually build, with the intention that the audience can establish causal links for each new layer. Again, this was most successful in the metaphor systems, as the use of a single metaphor limits the number of different simultaneous processes that can be produced by the system. In the case of *Church Belles*, compositional development is achieved through changing the behavior of the simulated objects (the bells become air raid sirens). In *Piece for Tape*, interest is added through gradually adding more instances of the metaphor that intermittently record and play back different parts of the live guitar and vocal at varying speed, direction and duration.

6.3. Interactive Liveness

All of the pieces demonstrate interactive liveness to some extent. However, because there is less separation between the human performer and computer system in the interactive-generative tool and typing approaches, inferring interactivity between two separate entities could be more difficult. In terms of demonstrating perceivable interaction between human and system processes, the challenge is to demonstrate that the human and machine performers are in some kind of dialogue, rather than simply allowing algorithmic processes to play out or perform a fixed instrumental or vocal part that is unaffected by the system's real-time behavior. *Willow* is perhaps the least successful in this regard, with the system mostly being limited to following the human performer and providing ornamentation. In parts of both *Rows*, *Columns*, *Collisions* and *Kafka-Esque*, the autonomy of the system enables the human performer to stop and listen (and demonstrate

to the audience that they are listening), before responding. In *Church Belles*, the interaction can be heard through the real-time pitch-shifting of the live vocal. In *Piece for Tape*, there is a section where the performer improvises with the system in a conversational style.

6.4. Aesthetic Liveness

There was considerable variation between systems in terms of aesthetic liveness. In *Rows*, *Columns*, *Collisions*, the system was successfully represented in the visuals. However, because the piece was essentially about the system, there was little to reveal in terms of deeper meaning. The visuals of *Willow* were effectively the user interface, and a much higher level of design would be required to offer any significant aesthetic value. *Kafka-Esque* demonstrates significant aesthetic liveness through the careful selection of sounds and images that relate directly to the meaning of the work. The metaphor systems are also successful in this regard as the metaphor determines the functioning, the look and the sound of the system as well as being intrinsic to the meaning of the song. In both the typing and the metaphor approaches, aesthetic liveness offers the audience an understanding not just of the system, but also of the composition itself.

7. Conclusions and Recommendations

This portfolio of work has demonstrated how interactive systems can be used for the live performance of popular music. The pieces and performances produced compliment similar work due to their applicability to popular music (Bown et al 2015), levels of

interactivity (Bown et al 2009) and/or overall liveness (Sanden 2013; Croft 2007). The portfolio also demonstrates how the use of interactive systems can develop an artist's range of expression (Waite 2014) and result in each performance of the work being a unique version (Jeongwon and Song 2002).

Of the four approaches discussed, the metaphor approach was the most successful overall against the identified liveness criteria. The interactive-generative tools and typing approaches were not as successful due to the performer controlling them directly rather than performing alongside them. In the tool-led guitar and vocal approach, the visuals did not successfully reveal the system behavior in a simple and coherent way, nor did they communicate any of the themes behind the piece itself.

The metaphor approach was also the most useful in terms of creating pieces that could be identified as popular music while allowing the interactive system significant agency. The interactive-generative tools and typing approaches resulted in more experimental material, while the tool-led guitar and vocal approach involved system behaviours that were controlled by instrumental input rather than generative processes. It should also be noted that although the metaphor approach was highly applicable to popular music, the durations of the pieces were significantly extended beyond the usual three to four minutes in order to allow space for system agency and to communicate liveness by gradually revealing how the system works to the audience.

The downside to the metaphor approach is that the simulation of real-world objects and their behaviors is not applicable to every compositional situation. While the tool-led

guitar and vocal approach of *Willow* offers more flexibility while maintaining the applicability to popular music, demonstrating liveness is more challenging. Future work with this type of system could examine a more nuanced approach in terms of the aesthetics of the system visuals and audio outputs that, like *Kafka-Esque*, are unique to the work being performed and link closely to underlying themes. More use could be made of gradual increases in complexity (as in *Rows, Columns and Collisions* and *Piece for Tape*) or dynamic mappings (as in *Church Belles*).

Though practice-led methodology (Nelson 2013) was integral to the identification, implementation and evaluation of the four approaches, further work could involve audience studies. Though feedback from peers and audiences were actively sought as part of the creative process, additional insights could potentially be gained by comparing the responses of audiences to the different approaches by using similar methodologies to Bin et al (2016) and Correia et al (2017).

Finally, it is worth looking again why liveness is important. Through the use of a broad concept of liveness (Sanden 2013; Croft 2007), this study and the accompanying collection of pieces aim to show that interactive systems can offer more to composers than new modes of expression and more to audiences than an understanding of technological processes. In keeping with current discussions on aura (Cascone 2002) and indeterminacy (Jeongwon and Song 2002), interactive systems allow performers to create a unique version of an enduring work in each performance, whilst enabling audiences to more deeply understand the ideas behind the composition itself.

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