

**Acoustic transmission of metadata in audio files using Sonic Quick Response Codes (SQRC)  
- Mark Sheppard, Rob Toulson & Jorg Fachner**

With the advent of high resolution recording and playback systems, a proportion of the ultrasonic frequency spectrum can potentially be utilised as a carrier for imperceptible data, which can be used to trigger events or to hold metadata in the form of, for example, an ISRC (International Standard Recording Code), a website URL or audio track liner notes. The Sonic Quick Response Code (SQRC) algorithm was previously proposed as a method for encoding inaudible acoustic metadata within a 96 kHz audio file in the 30-35 kHz range. With this rationale, any receiver that has sufficient bandwidth and decode software installed can immediately find metadata on the audio being played, without requiring fingerprint analysis or an active Internet connection. The SQRC method works by allocating centre frequencies representing alphanumeric characters at 100 Hz intervals, starting at 30 kHz. For example, the letter 'A' is therefore represented by energy at a frequency of 30,000 Hz, whereas the letter 'Z' is represented by the frequency 32,500 Hz.

This paper demonstrates the effectiveness of the SQRC algorithm when acoustically transmitted over distance, whilst evaluating combinations of high and lower resolution audio equipment. The SQRC method was tested with a range of playback loudspeakers, including high resolution studio monitors (with playback reproduction up to 50 kHz), as well as loudspeakers with reduced bandwidth performance. Equally, the testing evaluated SQRC with a number of microphones, including examples with high bandwidth capability, standard studio microphones, as well as those found on consumer mobile devices. In all cases, the effectiveness of the SQRC transmission was evaluated at a number of distances between the loudspeaker and microphone receiver, over a range from 10 cm to 5 meters. The research shows that the SQRC method is a viable acoustic protocol that could feasibly be utilised in a variety of practical applications.

**Acoustically transparent headphones - Neil Martin**

The object of this research is to improve the quality of a performer's acoustic environment when using headphones in the recording studio. This leads to foldback that sounds more natural, which in turn leads to performances of higher quality. The current situation:

When it is necessary for performers to use headphones in the recording studio - perhaps when making overdubs or playing with click tracks - the majority choose to place only one headphone on the ear, leaving the other ear uncovered. Single sided headphones are not uncommon. This suggested to our team that there is a need for an alternative.

Description of the innovation:

The team's prototype systems utilises a pair of standard headphones with a pair of microphones mounted near the ears. A small electronic circuit powers the microphones and mixes their signals with the foldback signal; and the performer has direct control of the amplitude of both signals.

What the innovation achieves:

This paper will summarise experimentation that has taken place with several prototypes, developed over the last few years. Initially the team gathered data which suggest the concept is effective by testing with various makes of headphones, microphones, and amplification systems. And then the team built and tested a series of prototype units, each comprising an independent headphone/microphone/amplifier setup.

The team has tested the prototype system in collaboration with a several professional performers, and analysed the resulting recordings. These tests have provided two outcomes:

1. The performers agreed that the prototype system produces an acoustic environment that is an improvement over that produced by the standard headphone arrangement; this enables a more comfortable performance, particularly in the more physically challenging passages, i.e. particularly loud and or high.
2. An analysis of the recordings suggests that when using the prototype system the performers were

better able to manage the energy they put into their performances; this produced a noticeably better quality of tone.

### **Anticipating the cryptopirate: “don’t bury treasure” and other potential preventative measures - Patrick Twaddle**

My paper will outline the potential for the unauthorized distribution and consumption of recorded music through blockchains. After the proliferation of Bitcoin and other cryptocurrencies, blockchain technology has increasingly gained credence among investors, financial institutions, information technologists, and futurists in the arts and media. It has caught the imagination of some artists and industry influencers much in the same way that the emergence of the Internet and compressed digital music formats did two decades ago. However, blockchains are envisioned as a more potent means of disintermediation and creative empowerment with the capacity for effective rights management and economic efficiencies. Legitimate blockchain enterprises and initiatives in the music industry are well underway, but relatively scant attention has been paid to the potential for nefarious or black-market applications.

The central premise of my paper is that, in the near future, there is significant risk of the emergence of blockchains which will traffic recorded music and other media without proper attribution, permission or compensation. Provided with effective protocols, blockchains are relatively easy to construct but may be exponentially more durable, dynamic and economically valuable than the BitTorrent and other peer-to-peer networks that currently underpin digital piracy. The illegitimate exploitation of recorded music may experience a resurgence if “cryptopirates” develop their own blockchains loaded with unauthorized copies. Hence, it seems prudent to extract some lessons from more than two decades of Internet-based digital piracy in order to develop preventative measures which could mitigate the allure and viability of blockchain-based piracy. While legal action and DRM technology has shown limited efficacy, market-based solutions are likely to be more socially acceptable and commercially viable. The first lesson to be drawn is summed up as “don’t bury treasure.” “Treasure” primarily refers to deep, rare, and premium catalogue. I will argue that deletion and restricted availability are harmful and unnecessary as catalogues can be digitally maintained and accessible at very low marginal cost. Secondly, “treasure” also refers to new recordings which are confined to limited release and prolonged exclusives. Creating scarcity, whether intentionally or through negligence, inflates an artefact’s value but is essentially artificial and unsustainable in the digital music economy. It is an important tool in marketing and customer segmentation, however, the effect tends to be short-lived and can backfire. Scarce artefacts become lucrative targets for illegitimate agents, whether black-market entrepreneurs or anti-capitalist activists. The second lesson: create and adopt legitimate blockchain-based platforms and devices promptly. Recent history indicates that resistance to technological innovations is ultimately futile. Napster and other illegitimate platforms made quick use of new technologies and addressed consumer demands well in advance of attractive market outlets. It seems the sooner artists, companies and associations can adapt and formulate new services and business models, the less value slippage is likely to occur.

The third lesson: provide quality through diversified options and value-added services. We should expect that music consumers will continue to demand greater convenience and better community-building mechanisms, and that some will seek superior audio quality and detailed “liner note” material. The renown and popularity of BitTorrent community Oink’s Pink Palace—hailed as the best repository of music that ever existed—serves as a potent example of the market failing to adequately address issues of quality, accessibility and information sharing.

### **Autons, agents and performance-gesture in the new modular paradigm - Nino Auricchio and Paul Borg**

The historic visual aesthetic of live electronic music performance is traditionally represented in the form of muted gestures and postmodern irony through artists like Kraftwerk, Depeche Mode and Gary Numan - autonomous characters using robotic-like movements to emphasise the use of technology in their performance and suggest the presence of artificial intelligence. This performance trope was quickly rejected however, as the digital revolution redefined established modes of musical mediation.

Performative gestures are necessary to excite or control the necessary components that might induce meaningful sound and offer clear visual cues to an audience. That is to say, there is an established relationship between physical gesture, the nature of that gesture and the perceived resultant sound. This proprioceptive relationship is explicit in the case of acoustic instruments. Computer-based music, however, dissolves the relationship between excitation and sonification and creates a disconnect that challenges notions of authenticity in live music performance (Paine, 2009, P. 214).

Composing music is often conceived as a cognitive process leading to a fixed recording, notation or performance outcome. The process of performing and composing with electronic modular instruments aligns more closely to generative and procedural processes that involve the presence of multiple agents at macro level. Agents within a modular instrument can be one or more chains of modules, which can function at different levels of autonomy, determinism and stochasticism. These agents can function either in a more autonomous and generative manner, where the composer has little or no real-time interaction with the instrument after the seed data has been triggered, or alternatively these agents can be less autonomous and more dependent upon the real-time actions of the composer / performer. A modular instrument is therefore an interactive system where a multitude of variants can be selected and shaped to provide stability in the blend between process and intuition driven approaches to composition and performance practice. However, the experimental and open-ended format of a modular instrument, as well as its ability to influence and subvert the composition and performance aesthetic, is an on-going creative pursuit.

This paper will consider ideas around creating performance-patches where the technology involved might afford varying degrees of autonomy, and how this might then determine or influence gesture in live modular-synth performances.

### **Bert: theatre soundtrack as interface for blind and visually impaired people - Mat Dalglish & Neil Reading**

Theatre performances typically rely heavily on visual information, for instance to convey narrative, or establish scene and context. This can pose significant challenges for blind and visually impaired audiences, and in some cases can exclude them entirely. Audio description for theatre attempts to surmount these barriers by translating the visual elements of a performance into a live, spoken commentary that fits between the gaps in on-stage dialogue. This is preceded by an optional touch tour that offers guided tactile experience of the stage and set, and a pre-recorded introduction that helps to confirm the functionality of the technological setup. However, if audio description for theatre is relatively well established in the UK, its methods are largely tested (Fryer, 2013), and there are numerous potential human and technological issues. For instance, from the perspective of the audio describer, dense dialogue inherently limits the opportunity for detailed description. Also, objective approaches to audio description do not take into account contextual or individual factors that can affect interpretation, and literal visualverbal translation may limit imaginative or alternative readings. At a more fundamental level, the very act of describing something sets up an expectation that it is somehow important or has a role in the performance, and attention can be inadvertently drawn to inconsequential facets at the expense of more vital information. There is also the impact of technology on service users: equipment can initially be fiddly to setup, the constant shifting between on-stage and in-ear sound can disrupt immersion, and the headsets used to relay audio description can be othering.

Drawing on film sound theorists Michel Chion (1994) and Stephen Deutsch (2007), and the notion of perceived affordances developed by Donald Norman (2013), this paper describes the exploration of an alternative model to audio description for theatre. Using Bert, a play by Dave Pitt about suicidal ideologies as a testbed, the alternative model employs ambiently-diffused music and sound design (i.e. a soundtrack) as a means by which blind and visually impaired people can access the performance. Where audio description for theatre is descriptive, the soundtrack is suggestive; its mixture of informative and emotive sounds forging an immersive sonic environment left open to individual interpretation. Two performances held in March 2017 at the Arena Theatre are described, initial findings from audience interviews are presented, and how the project fits with the broader aims of the venue is discussed. Finally, possibilities for future work are outlined.

## **Can I get a witness? the impact of contracting in the music ecosphere - Sally Gross**

At this juncture, where digital technology has facilitated the production of musical products in unimaginable quantities and where the international copyright system is being stretched to its limits, many argue it is contractual regulations that are attempting to shape this complex web of creativity and commerce (Dean, Fisher, Gilbert). From the Copyleft movement to anti-piracy regulations and the problems of policing the digital ecosystem have tended to dominated industry, academic and policy discussions. More recently the attention has turned to the impact of the growing 'gig' economy and the boundaries of what is even understood as work in the digital age (Dean, Fisher, Fuchs, Bunz). This paper seeks to turn the focus onto the place of contracting in the music ecosphere, paying particular attention to how the specter of contracts impact on the creative process and the way in which music producers experience and give meaning to their work through contracts.

Contracts symbolise unions, they are an exchange of promises, they should contain equal complementary obligations, made of free will between consenting adults. They mark significant moments in time and in our lives both personal and professional. Yet signing contracts in the creative sphere is often extremely difficult and full of contradictions, they often mark great moments of highs and lows for music makers and music producers alike. This qualitative research based on interviews with music makers and music professional seeks to analyse how the processes of contracting impacts on the affective realm of those seeking to create and work within the music ecosphere. In our recent study into the mental well-being of music professions we found that music creators and music workers always cite the significance of signing contracts (Gross, S. Musgrave, G 2017) 1, these contracts appear to have significant symbolical meaning. And there is clearly a hierarchy of contracts that map out different stages of creators and music professional's lives (Laing, D. Greenfield, S. Osbourn, C ) 2. Thus being sign or unsigned still appears to hold great significance in the way music workers talk about their work. Here I investigate what this significance is for music producers across the music supply chain from singers, writers, band, music producers and music managers and music industry professions.

## **Can Twitter Create Music? - Jeffrey Lupker**

Music has often followed societal trends so it seems only natural to suggest that the one of the biggest trends of recent times, social media, could be incorporated into music. Twitter was chosen for the present project due to the ease with which millions of users all over the world use this medium to communicate via short messages. Trending topics can be monitored to provide the input for analysis as many users are communicating about these topics during short time periods, creating a natural but highly complex rhythm. This situation, of course, closely resembles a piece of music in which a group of notes, all belonging to the same key, are played in succession over a short period of time.

The overall objective of this project is to realize Twitter as a functional music generator whereby pitch, velocity and duration of the notes are all determined by incoming tweets according to a specific search term, typically a trending topic, in real-time. My hypothesis is that the natural "rhythm of the world" that is created when users collaborate on a singular topic, a rhythm that will undoubtedly be complex yet compelling, can be meaningfully reflected through electronic music. Sentiment analysis of the text of each tweet will provide an additional dimension, the ability for the music to reflect when the topic is mostly positive or negative. Thus, the music should reflect how popular a topic is and the general feeling people have towards that particular subject.

The basic procedure involves the extraction of real-time tweet data from Twitter's streaming application programming interface (API) through java code rewritten to run in Cycling '74's Max 7 as a Max Java External (MXJ). The MXJ external outputs the username, time of tweet, and the body of text in the tweet which then can be analyzed by different Musical Instrument Digital Interface (MIDI) parameters to output sound. Username (i.e., when a user posts a tweet) will lead to the selection of a random pitch between MIDI values 21-108 (any note found on an 88-key piano). The body of text in a tweet is then examined for character count and undergoes sentiment analysis, the results of which will drive subsequent consonant or dissonant pitch selection. Character count between 0-140 is scaled to fit the velocity MIDI values of 0-127; in other words, the more said in a tweet, the louder the sound that is outputted. Finally, duration is determined by the time (in milliseconds) each particular tweet arrives after the one before it. Twitter trending topics can indeed generate music

based on the tweets that are sent. Compelling complex rhythms have been generated based on different topics which reflect user activity regarding what is trending. Within these rhythms, overall moods of the collective users are suggested through the controlled use of consonance vs. dissonance as the music progresses.

### **Collective creativity: a 'service' model of creativity in commercial pop music - Phill Harding & Paul Thompson**

In his introduction to *The Art of Record Production: An Introductory Reader for a New Academic Field* (Frith & Zagorski-Thomas, 2012), Simon Frith proposed that producers in pop and dance music genres have a significantly different role to music producers in other music genres such as rock. A prominent difference is that pop music producers are often part of a production team that involves direct collaboration and participation with songwriters, programmers, musicians, artists, management and record company representatives. Pop music songwriting and production teams are therefore more frequently part of a larger creative collective (Hennion, 1990) in creating a musical product.

The following study explores the creative production workflow system at Pete Waterman Ltd. (PWL) Studios during the 1980s and investigates the way in which Phil Harding and Ian Curnow (P&E) worked with manager and entrepreneur, Tom Watkins in the 1990s. Drawing upon a series of interviews and data gathered during an extended ethnographic and auto ethnographic study, this paper presents the pop music 'service' model, which underlines collectivist rather than individualist thinking and illustrates how evaluation is present (and co-current) at the ideation stage in the generation of creative ideas (Sawyer, 2003) at various stages of the commercial pop songwriting and production process.

### **Composing with microsound: an approach to structure and form when composing for acoustic instruments with electronics - Marc Estibeiro**

This paper explores the implications of using microsound as an organising principle when structuring composition for acoustic instruments and electronics. The ideas are presented in the context of a composition by the author for bass clarinet, flute, piano and electronics: *The Sea Turns Sand To Stone* (2015). After giving a definition of microsound, the compositional affordances of microsound are considered. Microsound is presented as an aesthetically rich tool for creating cohesion between acoustic and electroacoustic sounds and different parameters for manipulating the sounds are presented. Issues of structure and form are discussed and the challenges of creating a coherent environment that uses both note-based and texture-based material are explored. The implications of applying different models of form to mixed compositions are considered. This leads to a discussion of the different relationships that exist between the acoustic and the electroacoustic parts of a composition. Extended instrumental techniques provide one way of creating perceptual links between the acoustic and the electroacoustic. Examples of the way such techniques have been used in conjunction with microsound to impose a structural framework on *The Sea Turns Sand To Stone* are given. Finally, the use of a pure sound/noise axis, mediated through the application of microsound, is presented as a viable organising principle for structuring mixed compositions. The implications of such a model are explored and the underlying structure of *The Sea Turns Sand To Stone* is presented as a practical example of the application of the process.

### **Development of 'Times of High Water' - Stu Lambert**

The presentation discusses my taiko composition *Times of High Water* (ToHW). ToHW is algorithmic music, performed using taiko's full-body technique and aesthetic values of posture and movement.

The presentation discusses the challenges and solutions in performing rhythm patterns, which were not written to account for the possibility of performance, across six strike points on two drums. The composition asks the body to make the necessary moves in a frame that is approximately 2m x 1.5m. The frame covers a vertical range from the ground to the tip of a drum stick held aloft and a horizontally, across two 45 cm drums, plus movement beyond the last strike point.

Covering the full range of performance requires shapes and movements that are innovative in taiko, such as a 'sword draw', which moves diagonally upwards close to the body, unwrapping the arms at a precise moment. Achieving the rhythms with a taiko aesthetic, where drumming movements have beauty of form, brings further movement innovation.

The presentation considers the performance aesthetic. This is *kata*, 'form', a term used in karate. *Kata* is often thought of as observation of movement, but is actually sequential observations of *ma* (meaning 'space, pause, void'). *Ma* is usually used in taiko for observing stillness. Stop-frame animation and the Buddhist concept of *ichinen sanzen* '3,000 life states in an instant' are referenced in the discussion.

The presentation finally proposes that the deep study of *kata* can inform technique in the use of motion-sensing controllers in electronic music. Technology, such as Imogen Heap's mi-mu gloves, ask performers to move in two-dimensional free space; taiko brings full-body skills to this task.

### **#DIAD: do dull dials dream of being desirable? - Scott Hewitt**

Conceptual ability and the skill-sets needed to abstract complex structures are essential for the modern music technologist. Guitar effects pedals, synthesisers, and even the ubiquitous Digital Audio Workstation exhibit ever-increasing levels of complexity. Many digital modular systems such as Max/PD & Kyma, rely on virtually unlimited levels of permutation. However, the successful creative deployment of these complex structures can too often become a fruitless exercise without a conceptual groundwork to provide context. Re-exploring the defining moments in the history of western music and its theory can illuminate a creative roadmap to help synthesise new innovative ideas.

Bach, Schönberg, and Reich each have made their own contributions to the musical landscape. Some of their ideas, techniques, and philosophies have been explored in the presented work. Considering the necessary modifications to the natural harmonic series within Bach's innovative tempered system of tonality, and Schoenberg's attitude and defiance regarding the constrictions of this system as inspiration: certain notions have been reconstituted with the use of a unique sample manipulation structure. Phasing concepts explored by Steve Reich have inspired the creative execution of this work.

'The Optical Lettuce' is a multi-channel composition designed to explore the conceptual sphere outlined above. This piece has been inspired and constructed from different ideas and cues taken from an exploration of music history. The broader context for this work has been inspired by Leonard Bernstein's 1973 Harvard Lecture Series 'Unanswered Question'. Audio of a 4-minute stereo version will be presented to the conference.

The core technology used to realise the piece takes a single sample, plays 10 copies that are looped simultaneously and modulated in a number of ways. The arrangement is built from a variety of explorations of this framework. The algorithm to realise this was created on the Kyma Sound Design platform a decade ago, but was regarded then as a purely technical exploration; the creative possibilities were consciously not fully considered. Now, inspired by the phasing concepts explored by Steve Reich; speech, tonal, and atonal material was recorded to fully reexplore the sonic potential of the previously created structure.

A number of realisations have emerged from this process.

The simple act of looping and duplicating a piece of audio presents such a large range of possibility. The demonstrable links between signal phasing, filtering, comb filtering, and perceivable echo: all generated without a feedback loop is fascinating.

Relinquishing the rhythm and metre to arbitrary forces following the time honoured traditions of phasing music can provide the enquiring synthesist with fresh perspectives regarding pace, emergent symmetry, and antiphony.

The composition presented here represents a symbiotic conceptualisation of a technological framework with a hermeneutic exploration of the past to form innovative new perspectives. By exploring the innovators of the past it is possible to find inspiring truths to harness for innovative creative progress.

## **Disruption as contingency: music, blockchain, wtf. - Matthew Lovett**

In his 2016 TED talk, 'How the blockchain is changing money and business', the digital strategist Don Tapscott suggested that musicians and other creators of digital content, by cutting out intermediaries and protecting their intellectual property rights via an immutable distributed ledger, would be able to make it 'rain on the blockchain'.

Tapscott's tech-utopian view of the blockchain as a panacea that can correct the inefficiencies and shortfalls of current music industry practices squarely configures it as an example of what, in 1995, Clayton Christensen and John Bower called a 'disruptive technology'. A conventional reading of 'disruption' in this context is that a disruptive technology is one that challenges the *modus operandi* of existing business practice, such that start-ups, by offering more efficient and cheaper services, have the power to disrupt and eventually unseat established businesses and corporations. Hence Tapscott's assertion that the blockchain will 'make it rain' for musical creatives; allowing them to better protect their intellectual property rights and to increase their profit margins on sales and streams of digital content.

Thus Tapscott is able to confidently assure us that, in terms of current business practice, 'the genie is out of the bottle': blockchain will usher in a new phase for digital markets, that will flourish because of more direct relationships between content producers and audiences, and an ever-more dynamic and secure means of protecting creative rights.

However, the concept of disruption is far from static, or even resolved, and in his recent book 'The Disruption Dilemma', Joshua Gans discusses the way in which 'new innovations involve [...] changes in the entire architecture of a product rather than in the components themselves' (Gans, 2016: 10). This would suggest that new technologies threaten more than just those with a vested interest in current market practices, they also pose deeper threats to the very underpinnings of a given market ecosystem.

This paper seeks to go further still, by aligning disruption with current debates surrounding the nature of contingency in contemporary philosophical circles, wherein a number of contemporary thinkers including Ray Brassier, Quentin Meillassoux and Francois Laruelle have sought to bring together a range of perspectives, including quantum theory, to develop a sense of 'real' contingency wherein even the unexpected can't be expected...

In this sense, disruption as real contingency becomes a far more dynamic phenomenon within the context of digital commerce, and creative practice.

Just as Web 2.0 proved to be a very different kind of platform to both Web 1.0 and the mediatech industries that gave rise to it, in that allowed for the invention of a range of new behaviours and indeed emotional responses to music and media content, so too does blockchain offer the promise of something that we are not yet able to see. As a contingency technology, the blockchain might not simply make the music industry more efficient and more content creator friendly, it has the potential to fundamentally alter what the industry is.

## **Enhancing creativity through research: testing a novel spectral clarity measurement tool in the mix process - Kirsten Hermes**

Mixing music is a process whereby several tracks of recorded audio are combined to an overall piece. The loudness, dynamic envelope, spatial position, spectrum and other features of the tracks are adjusted. For a given multi-track recording, there are potentially an infinite number of ways the tracks could be combined into a final mix. Creating a high-quality mix is a complex process; difficulties arise from, for example, time constraints and lack of expertise. Furthermore, most mix tools are based on the physical properties of sound (e.g. level, spectral balance and intensity), rather than perceptual attributes such as loudness or clarity.

Since qualities seem to exist that all successful mixes have in common, it is useful to develop automatic mixing or metering tools and to subsequently test their impact on the creative process. In a prior research study (Hermes et al., 2017), it was established that the high-level parameters determining the perceived quality of a music mix are 'clarity and separation', 'balance', 'impact and interest' and 'freedom from technical faults', alongside context-specific parameters. The spectral clarity of isolated sounds — one particularly important parameter of music mixes — was investigated further. Spectral clarity refers to the degree to which the important components of a sound's natural

timbre can be heard and the extent to which the overall spectral shape of the sound facilitates this. In a series of experiments, it was established that two important factors contribute to the spectral clarity of single sounds. These are the harmonic centroid (a weighted centre mass of energy of a sound spectrum, Hermes et al., 2016) and spectral inconsistency (related to sharp peaks roughly in the middle of the frequency spectrum, Hermes et al., 2017). Naturally-occurring sounds, having spectra that fall with increasing frequency, can become more clear when low-Q equalisation is applied to boost the less-audible higher frequency regions (raising the harmonic centroid). However, if equalisation exaggerates or introduces timbrally unpleasant peaks or resonances (spectral unevenness) then these can mask or distract from other sonic components and lead to a clarity reduction. Two simple computational tools were devised to detect changes in these parameters (Hermes et al., 2017).

As an electronic artist, the author has been writing, producing, performing, mixing and mastering original songs for approximately ten years. In cases such as this, where the entire creative process is undertaken by just one person, external, objective feedback on the mix process can be useful. Therefore, the clarity metric was tested informally on a vocal recording from a progressive house music production. The vocal is mixed first without and then with the help of the metrics. It was observed that the use of the metric has a positive influence on the creative process, leading to an overall more satisfactory result.

### **Everything is musical: creating new instruments for musical expression and Interaction - Alayna Hughes & Pierluigi Figueroa**

Wearable technology and sensors have allowed musicians to integrate wireless controllers such as the MYO Armband and the Hot Hands into their performance. With the explosion of home fabrication and affordable microcontrollers' invention and music hacking has never been more accessible. Through the use of an Arduino board and a sensor everything can be turned into a musical instrument even a boring table can become an experimental MIDI controller for Ableton. While the technology has been growing less expensive and more accessible the creation of new devices and controllers can be seen emerging from the music hacking and maker community. The connection between music and maker has become greater to the point that Maker Faire Europe now includes not just an entire section devoted to musical inventions, but also Maker Music performances that include non-conventional instruments and performances that feature instruments made by the performers. During music hacking events such as Music Hack Day a hackathon held by Music Test Fest or another group' every team creates a performance or device to create a use for a sensor or product that could be used to integrate into the music world. Out of these creations' teams may continue to develop their idea into their own performance or product idea and launch a Kickstarter campaign stemming from their concept.

Through research and work as a performer, teacher, and artist, Alayna Hughes has explored the use of fabrics, brainwaves, muscles, virtual reality and gesture as a means of creating music and visuals. The art-music-tech group Curiosibot Hughes and Barberis have developed a wireless controller prototype suit for the artist Nona Hendryx, built robots to play music, hacked instruments, and most recently, built a room that is an interactive instrument controlled by movement. This paper will discuss the trends within the maker community along with experiments and creations using 3D printing, conductive fabrics and materials, and Arduino. The paper will also explore the possibilities of the effects and changes if more music hack and maker ideology were to be integrated into the music industry.

### **Exploring innovation in plugin design and utilization - Andrew Bourbon**

Audio plugins have become the sound-processing hub for the increasingly dominant in-the-box mixing environment. Through the history of plugin design there has been significant development in the nature of these processing tools, with increasing complexity in form, function and sonic capability. This paper will look at the development of plugins, identifying the key areas of innovation and looking at the future of innovation in audio processing.

The paper will explore a number of key areas where innovation has taken place. Firstly emulation will be explored, looking in depth at the complexity of the current generation of emulated plugins.



Though arguably lacking innovation on workflow there is clear innovation in the measurement of performance and component modeling, and in the integration of these classic tools into contemporary workflows. The second area for exploration lies in language and terminology, with developers looking to build on elements of musical language established through genres and mix engineer brands to innovate in their approach to design. These tools are often looking to remove barriers to user innovation, using semantic descriptors and established sounds to drive the end user.

The third area for investigation will look specifically at GUI design, particularly where the innovation is not just in the plugin itself but also in the creative opportunities for innovation offered to the user. A number of manufacturers are taking innovative approaches to established processes, providing new methods of control of established parameters and also providing new ways of manipulating components within the tool that would normally be hidden to the user. These tools are providing innovative opportunities to the engineer to explore established processes through new environments, often allowing interaction and control that would not be possible in similar hardware tools and encouraging innovative and creative approaches to audio processing.

The final area of exploration will focus on new processing paradigms, particularly exploring tools that allow complex spectral and envelope manipulation. Plugins in this category are at the cutting edge of innovation, offering new opportunities made possible through developments in processing power and the imaginations of those who develop the tools and the engineers who create the problems to be solved through innovation in design.

The 4 stated areas for investigation will be approached through a combination of performance measurement, feature evaluation and through contextualized musical exploration of the selected tools. The relationship between the user and the designer will be at the core of this innovation analysis, leading to a discussion as to the potential future for continued innovation in plugin design and usage.

### **Getting out of the box: tangible music production in the age of virtual tech abundance - Tim Nikolsky**

Engineers and music producers of today are increasingly divorced from the physical, real world tangibility of music production. Making music no longer requires you to reach over and turn a knob. Ideas of authenticity, appropriation and ownership in music production are rapidly being redefined. Calculations from the mathematical algorithm with the pretty pictures are increasingly being chosen over hardware containing heavy metal transformers and glowing tubes. Are mouse clicks and movements equivalent or inferior to the master brush strokes we are seeking to conjure?

We are making audio production decisions visually by constantly looking at a screen rather than listening. Have we compromised our musical objectives and values by removing the "hands-on" nature of music making? DAW interfaces are making our musical decisions for us not necessarily in our best interests. Technological innovation has presented opportunities as well as challenges for education. What do music production students (the next generation of music producers) actually need to learn in a formalised education environment, and to what extent do they need to know it?

In this brave new world of omnipresent music creation tools, do we still need tangibility in music production? This paper will provide insight to answering these questions and move towards developing an understanding of the music maker's relationship with tools, and how tangibility can be rediscovered in the next generation of music production.

### **Improvising through the senses: a performance approach with an indirect use of technology - Tychonas Michailidis**

The expressivity of musical performance is highly dependent on the feedback relationship between the performer and the instrument. Aural and haptic feedback are essential for the control and expressivity of a musical instrument.

Despite current advances, performers using technology often lack the facility to retain the same expressive nuances of acoustic instruments. This is exacerbated by the limitations of controllers and other sensor-based devices used in the performances. Due to their physical properties, such devices and components are unable to provide the same level of haptic experience between the instrument

and the user, thus breaking the link with traditional musical performance. Sensors and other controllers are often used to capture data from performers themselves and use them directly to control musical parameters such as reverb, volume and delay for example.

This paper proposes through a case study, an innovative way to interact, create and perform music. Rather than using the data from sensor technologies directly to control music parameters, the data are used to stimulate the performer's senses. Performers are presented with tactile, aural and visual feedback allowing them to process, identify and interpret their own mapping techniques between the senses and the instrument. Whilst the use of technology is essential in this setting there is no direct influence between the technology and the creative outcome. The performers are embedded within a feedback loop of the senses responsible to generate, process and perform.

The case study examines these feedback loop relationships between a dancer and a pianist. Gestures and movements from the dancer are captured and translated into vibrations for the pianist to experience. The vibrotactile information experienced can be associated for the control of articulation, tempo, phrasing and rhythmic patterns for example. The dancer also feels through vibrations the micro-movements of the pianist such as breathing and upper body performance gestures, thus creating a corporeal link between the two. Audio signal from the piano is analysed to generate the projected visuals for the dancer to receive creating a feedback loop between movement, sound and image.

The paper describes the approach taken in this case study identifying the limitations and the possibilities of technology. Moreover, it discusses the use of the bespoke wearable systems that provide vibrotactile feedback as well as the control of the visuals and other gesture capture systems. By radically transforming the way communication links are established within performing arts, new creative ways enable artists and researchers to interact with the technology.

### **Interactive music software: developing music technology for an interactive exhibition - Hans Lindetorp**

The purpose of this presentation is to describe the development of software (iMusic) for interactive music and how it has evolved as a result of being used in an interactive exhibition - Nobel Creations.

I developed iMusic 2013 to serve as prototyping tool and test bench for teaching interactive music at the Royal College of Music in Stockholm. Since then, more than 50 music production students have used iMusic in different projects where Nobel Creations plays the most important part. I have myself been responsible for the software development and the students have given valuable feedback for the design of new features. They have also had a great impact on the API to make it well suited for composers with little or no experience of programming. Nobel Creation was an interactive exhibition in Stockholm where students from different disciplines and universities interpreted the Nobel prize in music, design, photography and handicraft. There were two types of music in Nobel Creations. Six songs, interpreting each Nobel prize, composed by Jazz students. Those songs could be listened to through headphones. There was also an interactive music installation composed and produced by students at the Master's Programme in Music Production. The music installation was built of a continuous soundscape played back through two sets of stereo speaker and two sub woofers. There were also 12 speakers with discrete channels of musical phrases triggered by the visitors' movements captured by IR- sensors and interaction with iPads and buttons. This study was done 2014, 2015 and 2016 and focused only on the interactive music and its relation to the technology. Every year, the music was playing every day for three months starting the first week in December. When choosing technology there was an option to either use existing solutions like Ableton Live (with max for live), Wwise, Fmod, Elias or to build something new. To gain knowledge about how the composing and production process could be leading the innovation of new music software, we formed a research project and went for the latter.

To facilitate interactive music in Nobel Creations, lots of features have been added to the software. iMusic is similar to products built for game music but differs in some ways. I would argue that many of the innovations and features would not have happen if it weren't for the iterative process between the composers, the programmer and the exhibition itself. The engine has a focus on composer controlled, randomized playback, which supports the need for endless music during the exhibition. Another result of the project is the implementation of motifs (musically synchronized phrases) with features supporting the triggering of phrases in a musically controlled context regarding chords,

dynamics and time signatures.

### **Interactivity and liveness in popular music - Si Waite**

Using a practice-led methodology, this paper discusses an approach to the use of interactive music systems in the composition and performance of popular music. Reasons for the limited use of truly interactive systems in the performance of popular music are discussed, including the need to reproduce a recording, the emphasis on control, and the use of mediated material (Cascone, 2002).

Theories of interactivity and liveness inform the development of an interactive audio-visual work, 'Piece for Tape', where the system acts as a partner to a singer-songwriter in composition and performance. The system is afforded significant influence over the composition, both in real-time through 'performative agency' and in non-real-time through 'memetic agency' (Bown et al, 2014). The piece therefore balances fixed and indeterminate features so that while no two performances are ever quite the same, the identifying aspects of the song are preserved. Furthermore, the act of creating the system becomes part of the songwriting process (Richards, 2008).

In order to engage audiences, the system is designed to demonstrate the quality of 'transparency' (Fels et al, 2002; Bin et al, 2016), which can be thought of as a 'network of liveness' (Sanden, 2013). This is achieved through the use of the cassette tape as an audio-visual metaphor which informs the development of both the system and the composition. Transparency is created through the system having a presence in time and space; revealing the causes of sound events; demonstrating an interactive relationship with the human performer and linking aesthetically to the composition itself.

The piece is compared and contrasted with other similar works by the author that make use of interactive music systems, which vary in terms of the stage in the songwriting process the system is introduced; how much the system is a separate entity in performance and the extent of the use of the audio-visual metaphor.

### **Learning to satisfy your musical needs: competitive advantage in the music streaming market - Jack Webster**

Where once the marketing of mainstream music was dominated by the work of major record labels, music streaming services, such as Spotify, are now engaged in both the sales and marketing of music. Music streaming services are expanding their influence over how music is selected and presented to consumers within the space of their platforms. Led by the work of human curators and informed by the digital data they collect, Spotify have developed a range of influential playlist brands, such as Spotify's 'Peaceful Piano' and its 'New Music Friday UK,' and they are at the cutting edge of the use of music recommendation technologies to personalise consumer experiences.

These practices raise questions as to whether music streaming services' are disrupting the power relations of the recorded music industry and how they are encroaching on the work the actors traditionally engaged in the marketing of music. Yet these dynamics of power are still in formation and new research is needed to help us to better understand what the drivers of change are and how they come to have an effect.

This paper takes a snapshot of an industry in transition and proposes that this market disruption is in an outcome of music streaming services' development and mobilisation of a 'socio-technical capacity' (Gadrey 2000; Callon et al 2001) to learn how to satisfy the needs and preferences of their users. The concept of socio-technical capacity refers to an assemblage of human and technical competencies and resources which can be mobilised to achieve desired results (ibid). Music streaming services have privileged access to digital data about consumer identities and activities and they have developed a socio-technical capacity to extract insights from this data and learn how to best satisfy the musical tastes of their users. This enables them to optimise their marketing efforts in ways which have measurable impact on user engagement and retention.

This paper argues that this socio-technical capacity is a key source of competitive advantage for

music streaming services. Focussing on the case of Spotify and drawing on semistructured interviews with 15 music industry key informants and 7 recommendation experts, this paper unpacks the nature of Spotify's socio-technical capacity explores why and how it is developed and mobilised in order to advance its market position. It provides an account of how Spotify learns to satisfy the needs and preferences of its users and how these insights are used to optimise its marketing efforts. In doing so, this paper seeks to shed light on how the accumulation of data and the ability to extract value from it is driving disruption and innovation in the recorded music industry.

### **Listening aloud: a technology-assisted approach to widening participation in the music-making of OpenUp Music, specifically the forthcoming National Open Youth Orchestra - Kenneth McAlpine, Liz Lane, Barry Farrimond**

OpenUp Music 'empowers young disabled musicians to build inclusive youth orchestras. Together [they] develop accessible musical instruments and repertoire, challenge expectations and forge new progression routes through the creation of great music' ([www.openupmusic.org](http://www.openupmusic.org)).

The Open School Orchestras programme was initiated in 2014 and continues to be successfully rolled out throughout the UK. In 2016 the South-West Open Youth Orchestra, the UK's only disabled-led regional youth orchestra, was launched, led by young disabled musicians with high degrees of musical passion and potential. Their first year included the performance of a work specially written by Liz Lane, OpenUp Music's Composer in Association, at Bristol Cathedral, and live performances on Radio 3 as part of the 2016 BBC Music Day. The National Open Youth Orchestra will be launching in 2018. This work is timely and significant. Music-making has clear and tangible benefits for all, but traditional musical paradigms often preclude those with profound physical impairments. Limited mobility does not diminish our inner musical voice or temper a passion to play at the very highest levels – it is the way in which music is structured, its instruments, repertoire and a distinct lack of opportunity that prevents many with additional support needs from taking part. How might we overcome these issues and give individuals, in particular the young musicians of the National Open Youth Orchestra, meaningful musical autonomy that can allow them to engage fully with music-making at a high level?

This paper explores the transformative effect that music technology and physical computing have had in tackling this problem. For the past eight years OpenUp Music have engaged in an extensive programme of research, participatory design and development, adapting and revising every aspect of an instrument's interface, visual architecture and sound to meet the differentiated needs and abilities of the musicians they work with. This process has led to the creation of the Clarion, an instrument that can be played with any part of the body, including the eyes.

This approach places the work within an established tradition of practice: one that combines both lateral and incremental design stages. By presenting case study examples that demonstrate this process of design and its application to create expressive electronic musical instruments that are tailored towards the specific needs of disabled users, and their use as part of a live ensemble event, we demonstrate the positive impact that the work has had on groups of disabled users. We conclude by reflecting on the opportunities and the challenges that this work raises: how do composers adapt their practice when composing for technologically-assisted performance; how does the repertoire change to accommodate the new modes of expression that are opened up by technology, and how does this impact on ensemble leaders as they rehearse and stage performances.

### **MAMIC goes LIVE: a portable music visual programming system for the non-expert practitioner - Chris Payne and Mat Dalglish**

The computing curriculum in the United Kingdom has seen a dramatic shift from a 'software training' model to a model where children are encouraged to learn to code. This has created challenges for many primary school teaching practitioners, many of whom requiring upskilling. By interconnecting Music, Mathematics and Coding concepts through a LIVE USB deliverable system, the author's MAMIC (Music And Maths In Collaboration) library for the Pure Data visual programming environment, provides an easy-to-use but flexible and engaging means of teaching children to code within an interdisciplinary curriculum model. Unlike existing solutions, MAMIC is aimed at delivery by non-expert practitioners within the mainstream schooling system. Non-practitioner status is

achieved through a variety of means including, enclosed literature support, video demonstrations, examples of working code as well as a portable LIVE USB deliverable system. Consequently, MAMIC is packaged so non-expert teachers can boot the system without the need for hard disk installation. MAMIC is also designed to be used on the variety of computer systems that can be found in the education system. As a result, MAMIC includes detailed CPU reduction algorithms to enable it to run in realtime on a variety of primitive computer systems.

As well as detailing the MAMIC LIVE USB system, this paper also aims to introduce the initial research results produced by MAMIC and a non-expert practitioner. Initial MAMIC research encompasses the Unmoderated Remote Usability Testing (URUT) methodology. URUT provides a framework of usability testing, regarding products or interfaces within remote locations. Adopting URUT can determine how satisfied (or not satisfied) a user is with the interface and operability of a product. As a result, the non-expert practitioner tests the product for suitability in the real world. These details include qualitative analysis from the non-expert practitioner as well as video evidence of student work carried out so far.

### **Metal in the box: the DAW and the domain of authentic metal music practice since the mid-2000s - Mark Marrington**

This paper builds upon two areas of its author's recently published/forthcoming research (a) in regard to the DAW and its role in re-shaping popular music practice during the last decade and (b) the transformations that have occurred within metal music as a result of the use of software-based digital technologies. After providing some initial context highlighting issues relating to metal music's engagement with technology in general terms the paper will explore the impact of the DAW on the development of Progressive Metal since the late 2000s, with particular reference to the Djent subgenre and its more recent offshoots, such as Djent-step. The paper considers the influence of the DAW on the creation and production of Djent - for example, the influence of sample-based programming approaches on the music's sound, 'feel' and structure. Also discussed are Djent artists' incorporation of aesthetic practices and styles deriving from electronic music, including the use of synthesis techniques and mash-up. These in particular have raised important questions regarding the wider acceptance of the subgenre as authentic 'metal', while at the same time demonstrating the capacity of contemporary digital technologies to engender radical new forms of creativity that have ultimately enabled the metal genre to resist ossification.

### **Microgestural implementation for the creation of an expressive keyboard interface - Niccoló Granieri, James Dooley & Tychonas Michailidis**

Musicians spend a great deal of time practising their instrument. As a result, they develop a unique set of microgestures that define their personal sound: their acoustic signature. This personal palette of gestures has been identified as one of the most distinctive aspects of piano playing and varies from musician to musician, making their sound unique and enabling them to expressively convey their music.

Analysing current interface developments, microgestures are becoming integrated into digital instrument design. Taking as an example ROLI's Seaboard and Andrew McPherson's TouchKeys, what seems to be the common thread is the need to modify the keyboard interface to accommodate physical ways of transforming microgestures into sound control parameters. Both of these examples have achieved this additional layer of expressiveness through instrument modification.

By using radar millimetre waves to capture micromotions and microgestures, this research aims to achieve a high level of expressivity without the need to modify the keyboard instrument itself or requiring additional technique. The aim of this research is to build on existing instrumental technique and remove the steep learning curve typical when approaching an unfamiliar instrument. This approach enables the pianist to retain and focus on his or her technical control and musical freedom resulting in a less disruptive experience. As a result of the initial prototyping and testing phases, an interface capable of analysing two basic gestures on different axes was developed. The gestures taken into consideration, lateral swaying and palm height, are both classified as sound accompanying gestures or that take place after the production of sound (i.e. hitting the piano key). The system maps these gestures to pitch and volume, resulting in an intuitive understanding

between the relationship of hand-gesture and sound modulation.

The paper describes how the interface enables musicians wider control over digital sound processing, by implementing gestural sound control drawing upon pre-learned technique. Further observations will be conducted to identify which musicians will mostly benefit from the interface analysing their musical background, level of expertise on the instrument, familiarity with digital instruments and music environments

### **Mix and persona - Dan Sanders**

In the sphere of professional music production it is not uncommon to hear of mixes of multi-track recordings being rejected by A&R, label executives or artists due to a perception of somehow failing to represent the performer appropriately. Because of this, many mix engineers approach their role with the intent of portraying the performers as effectively as possible. Does this evidence a link between the blend of multi-track material and the persona of the artist in the recordings? How can this be tested? Can the black box between the intent of the engineer and the output to the audience be opened? In pursuit of this, examples of rejected mixes and their subsequent replacements were sought, analysed and evaluated for relevance. Persona traits were derived from existing publicity material and visual imagery then considered against both stated and inferred aims of production teams sourced from contemporary reportage and documentation. Frameworks employed include soundstage/sound-box visualisation, advice from established professional mix engineers in both professional and consumer-facing texts, and technological, musical and critical research on the nature of listening and preparation of recorded sound.

The resulting comparison of rejected mixes revealed a complex picture of influences; a number of plausible links between reported intent and musical outcome were discovered. Along the process, a small-scale data collection exercise was organised with response groups who were asked to listen to selected music and consider their inferences of artistic persona traits, additionally stating their level of familiarity with the artist. Results here suggest that that familiarity is not wholly relevant in persona perception, supporting the premise but revealing new questions indicating that further investigation into the topic may be valid.

### **Mixing and recording a small orchestral ensemble to create a large orchestral sound - Jenna Donnelly**

The prominence of restrictive music budgets in music for various forms of media is becoming increasingly apparent. Composers are employing various approaches to create the illusion of large-scale recordings using specialist recording and production techniques. In this paper, I aim to explore new ways of recording and mixing 14 live players in a controlled studio environment (specifically 5 strings, 2 keyboards, 2 percussionists and 5 brass) which will successfully give the listener the impression of a full-scale orchestra (90 players or more).

The recorded piece at the centre of this research is music theatre show *The Battle of Boat*, a 120-minute-long piece for 14 instrumental players and 27 young performers/vocalists, written by Ethan Lewis Maltby (Senior Lecturer, Commercial Music, Canterbury Christ Church University) and Jenna Donnelly (Course Leader, Music for Media, Ravensbourne). The musical was originally written for an orchestra, but the National Youth Music Theatre requested a 14-piece ensemble version for the live premiere in August 2016 (at the Rose Theatre, Kingston). The cast recording, recorded in January – February 2017, aimed to upscale this 14-piece to a much grander sound using innovative recording and production techniques.

This paper will explore miking techniques, mixing methods and combining 'live' stem with 'faux' VST-orchestra stems to achieve the final recording. The choice of microphones and their various placements had a substantial effect on the aural size of the piece, particularly when placed against VST instruments which mirrored the equivalent part in the overall mix. Working with mixing engineer John Merriman at Crown Lane Studios in Morden, it was discovered that the approach to reverb was particularly important in 'gluing' the various live and sample-based elements together. The ability to create such a large orchestral sound on a relatively small budget is very desirable to the larger music-production community, not just music theatre, so the outcome of this research may prove informative for a very large audience. The piece was played to a sample of professional musicians

and 'non-musicians' (those who do not engage in the playing or creation of music), unaware of the number of live players, who gave valuable qualitative feedback. The analysis concluded that non-musicians are more likely to be aurally 'deceived' than professional musicians, but those who did perceive the production techniques considered the aural size of the piece to be enhanced beyond the scope of a traditional orchestra, introducing interesting questions with regard to the future of recorded orchestral music for media.

### **Mixing beyond the box: analysing contemporary recording studio practice - Alex Stevenson**

Digital Audio Workstations have become the dominant element within recording studio workflows (Paterson, 2016). Despite DAWs often being designed to physically emulate the existing analogue equipment they replace (see Bell, Hein, & Ratcliff, 2015), the central role of DAWs play has led to the emergence of new studio practices which are often incorporated alongside, or adapted from traditional analogue recording techniques, for example the impact of virtual mixers and digital plugins on signal processing, signal routing and conventional analogue console workflows. Consequently, the vast majority of professional recording and production facilities have adopted different forms of hybrid systems that include digital recording, mixing and automation alongside analogue consoles and outboard processors and effects.

The demise of music recording and production budgets, alongside the closure of a significant number of professional recording studios in the past decade or so, has led to significant shifts in the both working methods, and working environments of engineers and producers, with many now undertaking some, or all of their work in smaller, sometimes home-based recording facilities, utilising traditional larger recording studios only when they are specifically required (such as for drum or orchestral recording). Although analogue processors, effects and summing are still often favoured by producers and engineers, it is now becoming more common for outboard devices to be routed into the DAW rather than monitored through an analogue console. Coupled with the common requirement for mix 'tweaks', alternative mix versions and mix stems, working 'in the box' has become an integral part of the work flow for the vast majority of mixing engineers working in the industry.

Through analysis of semi-structured interviews with a number of commercially successful record producers and mixing and mastering engineers, this paper examines current recording studio practice with a specific focus on the mixing process. It identifies how practitioners have developed strategies to address the changing requirements of the music industries, highlighting the various adaptations and hybridisations of analogue recording studio practices within the digital domain. Building on existing research in this field by Bromham (2016), It also aims to propose some initial recommendations on how these strategies could be usefully integrated into educational courses and training programmes that relate to audio production and sound recording to enable the engineers and producers of the future to be able to fully utilise existing and emerging analogue and digital technology in their workflows.

### **Mobilise: music, sound and mobile performance practice - Steve Jones, Peter Sinclair, Elena Biserna, Aneek Thapar, Norbert Schnell & Benjamin Matuszewski**

This paper describes Mobilise, an event that saw a diverse range of academics, artists, engineers and practitioners come together to share their approaches to mobility, experimental sound and innovative music performance. Key speakers included; Peter Sinclair and Elena Biserna (Locus Sonus, FR), Norbert Schnell and Benjamin Matuszewski (Ircam, FR), Frauke Behrendt (University of Brighton, UK), Aneek Thapar (NinjaJamm, UK), Jakob Haq (Haq AttaQ, SWE) and Steve Jones (De Montfort University, UK).

The paper presents the themes and ideas that emerged during a series of workshop sessions, hands-on programming, discussions, presentations and live performances. It examines different approaches to mobile practice, where they intersect or diverge, offer observations regarding the ways that mobile media is reshaping social and personal practices, and draw out conclusions from key speakers. The paper builds on theoretical work in sound studies, embodiment and relational aesthetics, as well as practical work developing strategies for rapid prototyping of networked mobile applications and real-time participatory experiences between programmers, performers and

audience. We discuss not only technology, but reflect on the value of collective music making activities, the relationship between sound, data and media, and the creative use and misuse of commercial devices for artistic purposes.

Mobilise explores a variety of issues including; web audio, live streaming as musical score, problems and solutions for disseminating offline performance, distributing sound through an audience's Smartphones, and the social aspects of self-directed music-making and collective composition. This paper intends to not only be an oversight into the rapidly evolving field of mobile music and sound art projects, but offer a reflection into the (im)materiality of mobile media, exploiting the constraints – inherited and self-imposed – of Smartphones and tablets in the development of new mobile performance practices.

### **Modulars, microchips and LSD: how psychedelics and spirituality shaped the electronic music ecosystem - Ryan Diduck**

The common use of psychedelics and broadly liberal attitudes of young Western society reflected a cultural mode of radical experimentation at the end of the 1960s. Rock and Roll music began to integrate aesthetic aspects of Eastern mysticism and spirituality. For instance, the Beatles' widely reported and high-profile retreat to India in 1968 helped popularize the idea that musicians should take a deeper interest in religions and seek out doctrines beyond Christianity—and that experimental music was the medium to catalyze transcendental experiences. Concurrently, new kinds of musical instruments were entering the marketplace. Engineers like Robert Moog, Alan R. Pearlman, and Peter Zinovieff had recently pioneered technologies that could synthesize sound, and the new class of "Progressive Rock" musician was eager to incorporate these synthesizers and other gadgetry. Pink Floyd, Emerson Lake and Palmer, and The Mahavishnu Orchestra, for example, gained fame in the early '70s for performing amidst constellations of novel electronic gear. Quickly, a second generation of musical instrument makers including those at E-Mu and Sequential Circuits capitalized on this progressive sound, manufacturing state-of-the-art machines that were directly influenced by the psychedelic experience. Often, the sounds they made were "out of this world." This paper will present an original perspective on an important moment in the West—the approximately fifteen-year period between 1969 and '83—when drugs, spirituality, and electronic music converged to drive innovations in new technology. I will argue that this convergence produced a rare ecosystem of inventive instrument makers, Avant-Garde artists, and unusually dedicated audiences—a singularly unified scene engaged in a manner of groundbreaking cultural overproduction. I will conclude that this excess of mystical techno-culture laid the foundations for what we generally today call "the digital era" in music, technology, and media.

### **MondriSonic II : composing interaction - Tim Sayer**

This presentation provides a theoretical and philosophical rationale for the research being undertaken in the area of biofeedback and human computer interface design, in the context of musical improvisation. This research has a creative focus and has recently produced its first output (mondriSonic), in which an animated graphic score responds to an EEG signal from a 'brain performer' as they are stimulated by the improvisation of an instrumentalist. The presentation will include video footage of the original system and current work in progress.

The theoretical underpinning for this work has been inspired by the writing of Merlin Donald and his notion of cognitive-cultural networks and provides an arena in which to explore the relationship between conscious and non-conscious decision making processes in improvised musical performance and the cultural influence on these processes by the performance context. Merlin Donald suggests that self-awareness and the facility to consciously direct attention emerged in humans, in the first instance, as an extension of our capacity to manifest behavior resulting from the observed experience of others. (Engel & Singer, 2008)

This presentation will outline future developments in the project, influenced by Di Scipio's theory of eco-systemic design in interactive systems, in which man/machine interaction is augmented to include man/ambience/machine. Di Scipio asserts " direct man/machine interactions (via control devices) are optional to an ecosystemic design, as they are replaced with a permanent indirect interrelationship mediated by the ambience" (Di Scipio, 2003). In the next version of the project,



direct conscious control of technological processes will be removed from the performance environment. The mechanics of the interaction will be driven entirely through the level of focused attention stimulated in the 'brain performer' by the environment, primarily through the auditory system via the human instrumentalist and the software algorithms. This will create a curious feedback loop, where the instrumentalist is responding to a graphic score, which in-turn is being manipulated by the reflexive brain activity of someone who is listening to a combination of the sounds generated by the score and the instrumentalist.

### **Music creativity today as a glimpse of all creativities tomorrow - David Gauntlett**

My book *Making is Connecting*, published in 2011, discussed various ways in which making things gives people a voice and sense of purpose in the world, connects them with others, and builds a broader sense of cultural vitality and social resilience. During 2017 I have been preparing a Second Edition, to be published next year, in which today's cultures of music production and distribution play an ever-greater role.

Music creators were the first 'victims' of the internet, as easily exchanged digital files almost destroyed the capacity of businesses to charge money for recordings. But this has meant that music makers have also had to become pioneers in the new worlds of online and offline innovation, offering valuable models of success and sometimes failure to their creative counterparts in other spheres.

Being able to short-circuit the established music industries and connect directly with the interested communities of people who might variously celebrate, inspire and pay for an artists' work has meant that music producers have been pioneers in creative entrepreneurship, crowdfunding, social networks, and forging new connections between online and offline creative practice. These changes have diversified the ways that artists produce and circulate work, and has enabled – among other things – women to establish their own labels for their own music, evading the often sexist modes of promotion used by companies in the past.

This story is well-known. All of it is exciting, but hard, and brings new challenges.

In this presentation I will consider the lessons that can be learned from recent transformations in the worlds of music-making, distribution and selling, looking in particular at creative practice and the new ways in which music artists show work in progress, and involve followers in their creative process. Music has become a platform for creativity and participation, which of course is what music was before the invention of recording technologies. Today, music is again a visceral, creative, individual and collective battle to innovate, create and exchange – and to be heard – supported by technological platforms but driven by human inventiveness. In other words, musicmaking has become more medieval – in a good way. Will this be the model for all interesting acts of creativity in the future?

### **Music in culture 3.0: 'mashing-up' boundaries between music, academia, culture and curation - Carola Boehm**

There is a renewed call for public/academia interaction where the engagement with new knowledge production is designed into the research process right from the start. The current terms relevant for this debate are 'triple and quadruple helixes', 'Open Innovation 2.0' and 'Mode 3 research'. Simultaneously and specifically within music and arts, there has been an increasing momentum in, and a public appetite for, process (rather than product), and the 21st century has witnessed a new phenomenon, that which Pierre Luigi Sacco (2015) has labelled Culture 3.0, characterized by the use of open platforms, democratic systems, ubiquitously available production tools and individuals constantly shifting and renegotiating their roles between producing and consuming content. Sacco furthermore suggests that Europe is hung up on Culture 1.0, characterized by a distinction of high-brow vs low-brow, arts patronage, gatekeepers and value absorption. This article will attempt to contextualize these concepts as part of the need to create interfaces between academic communities of research embedded practice and the wider society. The intentional act of curating these interfaces can thus be a sense-making creative process. A case study, using small-scale academically housed art/music centres, will make evident that there is the need for a deeper understanding of the cultural relativity of music-related practices and the roles that universities play to facilitate various cultural co-produced interfaces between music, culture, industry and society.

## **Music technology for those with complex needs - Asha Ward**

People with complex needs can face barriers to participation with music-making and sound exploration activities when using instruments and technology aimed at typically able users. My research explores the creation of novel and bespoke hardware and software to allow accessibility to music creation for those with cognitive, physical, or sensory impairments and disabilities. Using tools like Arduino and sensor based hardware, alongside software such as Max/MSP and Ableton Live, the aim is to provide innovative systems that allow for the creation of personal instruments that tailor to individual needs and capabilities. These instruments can then be used to interact with sound in new ways not available with traditional acoustic instruments. Several instruments have been developed so far as the research is in its second year. These include;

- filterBox - a wireless handheld wooden instrument featuring a light dependent resistor, 2 buttons, and a force sensitive resistor with a software element to allow for these controls to be mapped to musical parameters
- squishyDrum – a wireless handheld wooden circular box with an elasticated fabric top featuring pressure sensors that allow for detection of the distortion of the surface of the elastic. This can then be used to control musical parameters
- senseBox – a long wooden tabletop instrument with 12 different type of sensor mounted, used to explore the different mechanisms for controlling sound with the computer
- jackBox – a handheld wireless box featuring 3 jack sockets that allow for different sensors to be ‘jacked in’, each of which can then be used to control sound parameters in the bespoke software patch developed

Previous work has also included the SenseEgg. An egg shaped handheld wireless controller featuring 5 different types of sensor and a series of software patches designed in Max/MSP and also set-up to work with the iPad, that allow for the exploration of musical themes for children with special educational needs.

## **New opportunities for production of “live” church organ recordings - Jan-Olof Gullö**

The purpose of this paper is to describe a recording project where modern music production technology was used innovatively to record church organ, a very traditional music genre. This project is a part of a research project on creativity in music production, a project that so far has resulted in a couple of publications and refers to recent research in music production technology and research on creativity in music.

The background of this project is that the organ was renovated in a church in a small Swedish town. Although the church dates back to the Middle Ages, the pipe organ in the stands was built in the seventies. And during a recent major renovation of the church a new digitally controlled remote console was installed that holds the manuals, pedals, and stop controls. The remote console is connected with the old pipe organ as well as with new digital expansions. The digital expansions are played out in multiple loudspeakers. The over all purpose with the project was to make a recording, as documentation, of how the renovated and expanded organ sounds in different registers and dynamics.

One problem during the music production work was that next to the church there is a busy road and a bridge with loud warning signals. Therefore, it was difficult to record in the daytime and we had to record in the night when the surroundings were quieter. One problem with this procedure was that all of us involved in the project would need to spend many hours in the middle of the night, perhaps during a week or two to finish the recordings. The solution was to use modern technology creatively.

The digital communication between the remote console, in the middle of the church, and the organ in the stands is done with MIDI. And instead of playing the music live while we were recording, the music was first recorded digitally in music production software. This was carried out in daytime during a few production weeks. When we were pleased with the musical results, we recorded the entire album acoustically one night. During the recordings the performer, the organist, instead of playing

the organ, played back the pre-recorded music from the music production software live in the organ. To record the audio a straightforward stereo microphone technique and other relevant recording equipment was used. The results, a CD-record, was published a shortly after the recordings and editing was completed.

This production method may challenge our understanding of what “live” is. And since Church organs with MIDI and digital expansions opens up for new creative opportunities for both composers and musicians we may also see new formats or production methods in the future. For example, various church organs can play simultaneously through remote access. Another aspect is how digital expansions of traditional church organs can be used creatively, perhaps with other MIDI-controlled instruments. This project therefore provides a good basis for further artistic and technological experimentation.

### **Perspectives on musical time and human/machine agency in the development of performance systems for live electronic music - John Robert Ferguson & Paul Vandemast-Bell**

This paper investigates the exploration of musical time in Live Electronic Music and discusses the authors' novel, technological systems that embrace experimental processes and discovery. Prevalent theories of creativity are investigated, as well as tools and techniques that can be utilised to provoke unanticipated, but satisfying outcomes. The exploratory use of digital tools and chance operations is considered alongside more determinate predictable processes. While musical metre in commercial music production often revolves around metronomic timing, and the industry-standard quantization grid can often steer producers towards chronometric precision, this is at odds with expressive human timing. By standardizing the way in which we perceive musical time, much commercial software fails to recognise the full worth of musical metre and misses opportunities to explore alternative modes of rhythm and groove. However, some software does include a capacity to move beyond quantization grid restrictions and delve into an exciting world of complex timing, and graphical programming/generative music can also offer exciting possibilities.

This paper reflects on a number of practical experiments and new works that foreground rhythmical complexity. Some familiar historical examples are also contextualised alongside relevant contemporary artists. The authors foreground their own practices; Ferguson draws from recent work including 'Drum Thing', which celebrates the automation of percussion objects using computer-controlled solenoids, with software written in Pure data this project explores various approaches to randomisation with an Euclidean rhythm generator, where the greatest common divisor of two numbers is used rhythmically to drive beats and silences. Ferguson also discusses his work with 'Circles', where semi-random/quasi-intelligent sequencing and the creative negotiation of imagined agency is the main agenda. Vandemast-Bell's work draws on contemporary Techno music in which he explores techniques not unlike those pioneered by Steve Reich and later developed by Brian Eno in their experiments with phase. He uses original electronic source material that is presented then deconstructed and improvisationally reimagined in real-time, to create synchronous / asynchronous rhythms and textures. Dynamic audio looping plays a central role in his performances and is invoked through Native Kontrol's MIDI Remote Scripts for Ableton Live that extends Live's looping potential. He uses a custom Ableton Push controller mapping to interact with the electronic material, which is evolved through the use of audio effects and dynamic processors.

The overall agenda is to elucidate the role of human/technological agency. The authors reflect upon and compare/contrast their individual practices, from initial concept through creative process to final realization. Further to these individual perspectives, they collaboratively develop and discuss new musical materials and algorithmic processes using Pure data, these patches will be published with the paper, the overall goal being to encapsulate their collaborative perspective on the generation of complex rhythmical material in Live Electronic Music.

### **Press play on tape: 8-bit composition and musical innovation through technical constraint - Kenny McAlpine**

Constraint has always been a powerful driver, perhaps even a prerequisite, for musical creativity. Every culture expresses shared ideas about musicality, and arguably, it is the role of the musician

both to satisfy and to challenge these by extrapolating from cultural norms and subverting them. By stepping transgressively outside the boundaries of our culturally-agreed notions of taste and aesthetic preference, musicians can explore and map out new creative territories, before a process of refinement, repetition and reification consolidates them to create a new musical landscape. Without this process, music would develop by aleatory, making it near-impossible to recognize or appreciate musical creativity.

One style of music for which constraint was the primary driver is the 8-bit video game soundtrack, which has continued currency both through the popular trend for retrogaming and through chiptune, a minimalist electronic style that evolved from the programmable sound generators (PSGs) of the first generation of home computers and video game consoles, and that coaxes the hardware into performing feats of musicality that it was not designed to achieve. Video game music is, at least in part, functional: just think of the attract mode of many arcade games, non-playable demos used to entice the quarters of prospective gamers. It is a type of media music, whose form and structure is determined, at least in part, by factors that lie outside the music itself. From the outset, those early video game composers were driven by the need to create catchy tunes that worked repetitively and that reflected the game content, but which had to compete for meagre computational resources with the game's mechanics and graphics, and be realized on sound chips that offered little in the way of musical expression, usually only a few channels of polyphony and a prescriptive palette of simple waveforms.

Those early days of video gaming are replete with tales of ingenuity as coders and musicians – and often they were one and the same – developed novel tricks to expand the capabilities of their machines. But the approaches that were adopted to broaden and expand the musical capabilities of PSGs were not without cost, and their application often imparted a unique characteristic to the sound. Over time, those characteristics came to define the aesthetic, if not the style, of the 8-bit computer soundtrack.

In this paper, we present a platform perspective on musicological analysis, an innovative approach that considers how the hardware of one machine, the Commodore 64, and the code that was written for it shaped the qualities of 8-bit video game music. By considering musical analysis from this point of view, we begin to appreciate the challenges — both creative and technical — that presented to those early game designers, and the routes through which the chip sound evolved. Featuring exclusive interviews with notable 8-bit composers of the time, including Rob Hubbard and Ben Daglish, the paper explores how a unique combination of musical and machine expression defined the sound of an era.

### **Questioning progress narratives in contemporary studio production - Joe Watson**

In our headlong rush to embrace all thing digital as synonymous with 'the future' perhaps we run the risk of forgetting important insights from the past.

This paper presents ongoing practice-based research into recording and production using analogue multi-track tape. The author has many years of experience engineering and/or producing using digital technologies (including Stereolab, High Llamas) and now turns his attention to the DAW's analogue 'forebears' in self-production of his third Junior Electronics solo pop album. Given the skeuomorphic nature of the DAW, and its indebtedness to the legacy of traditional analogue engineering, what insights can be gleaned by engaging with the actual analogue equipment itself? As the DAW increasingly swallows up the whole studio (recorder, mixer, outboard, instruments, personnel) within the 'square horizon' (Virilio) of the screen, what can be learnt by the digitally literate producer/composer from the extreme constraints of a fully analogue production process?

The constraints placed on the making of this album are simple – there shall be no digital audio, or digitisation of audio, at any point in the production of the finished record – the album will be tracked to 1/2 inch 8 track, mixed to stereo tape and mastered to vinyl. Digital processes and media may be employed for purposes of documentation and demoing.

What are the practical effects on the music produced if an artist used to 'unlimited' tracks is forced to work with only 8? What are the effects on the production process when editing is restricted to what one can achieve with a razor blade?

Given the healthy currency of analogue technologies (vinyl, modular synthesis, cassette labels,

traditional analogue studios (such as Albini's Electrical Audio)) why is 'the analogue' consistently periodised as digital's early/obsolete 'other'?

### **Reconstruction of transient digital audio workstation signals at high-resolution sample frequencies– Rob Toulson**

The ideal digital-to-analogue (DAC) reconstruction theory described by the Whittaker-Shannon Interpolation Formula (WSIF) is used to investigate how accurately digital audio workstation (DAW) signals are reconstructed, and explores whether high-resolution sample frequencies provide a performance advantage. The ideal reconstruction profiles are then evaluated against the actual reconstruction data captured from signal playback in a common DAW through three pro-audio DACs, and at multiple sample frequencies of 44.1, 96 and 192 kHz. The test signal used is an 8 kHz sine wave that has been created within a common DAW and has been amplitude-shaped with the DAW automation tool, yielding a short transient signal. The test signal is chosen to enable analysis of a unique DAW-created signal, and also to evaluate the performance of DACs when presented with transient data that approaches the Nyquist sample frequency (in the case of 44.1 kHz sampling), whilst still being audible to healthy listeners. This approach is chosen because it has the potential to yield information on the suggested benefits of higher-than-Nyquist sample and reconstruction approaches in a real-world music production context.

It is seen from both the mathematical models and the hardware testing, that spectral and temporal artefacts are introduced during reconstruction of the test signal. In the ideal case, this is owing to limitations of the WSIF when reconstructing data that holds energy at frequencies close to the Nyquist limit. In both modelling and hardware analysis, the 192 kHz reconstruction of the transient test signal shows greater temporal accuracy and less introduced spectral artefact. Transient signals reproduced at lower sample frequencies are seen to have more shallow gradients of attack with delayed positioning of the transient peak, as well as having potentially audible artefacts introduced in the frequency domain.

### **(Re)Engineering the cultural object: sonic pasts in Hip-Hop's future - Mike Exarchos**

Through the process of sampling, Hip-Hop music has largely depended upon the phonographic past for its function, output and sonic aesthetic. Yet at the heart of its modus operandi lies a controversial methodology, conflicted with ethical, legal and pragmatic issues concerning the use of previously recorded phonographic content. The high premiums involved in sample clearance have restricted producers' access to raw sonic materials, while there are increasing signs that the practice may be running low on renewable energy sources.

Producer Domino (cited in Schloss 2014, p.164) claims: "I just think that, now, you're getting to the point where ... you're running out of things to find. And so a lot of the best loops have been used already." As a result, rap practitioners have been pursuing alternative routes towards music creation, including the recording of live instrumentation; an approach that continues to receive considerable criticism by the hip-hop community in terms of its stylistic viability. In their recent promotional campaign for and the Anonymous Nobody, De La Soul (2017) inform us that their "first album in 11 years was born of 300 hours of live material, converging bossa nova, soul and hip-hop to funk, disco and reggae," and for its deluxe edition they have included "both the studio and instrumental tracks" in the release. But if rap producers have to resort to the creation of material facilitating an intermediate production phase, it is important to consider the variables that enable effective interaction between source content and the hip-hop process. The paper suggests that Hip-Hop's 'meta' aesthetic is borne out of the fusion of sampling processes with (past) phonographic signatures, and it examines the bi-directional dynamic involved in their (re)construction within a sample-based context. Through a reverse-engineering methodology deploying (auto)ethnography and reflexivity, the research explores the potential for constructing referential sonic objects within a hip-hop workflow, aiming at a typology of techniques that can empower future practitioners beyond legal restrictions. Furthermore, the investigation questions Hip-Hop's complex relationship with the past, the extent to which historic and stylistic referentiality is necessitated by the pursuit of its sonic aesthetic, and the suitability of DIY techniques in the actualization of its future development.

## **Sample clearances, iTunes for samplers - Stephen Partridge**

This abstract relates to an applied research project based upon Mashupaudio.com. This is perhaps best described as an enhanced iTunes for producers of sample-based music; an application that allows music producers to sift through music that they may wish to incorporate into their own productions and then download discreet parts (or stems) that are of interest to them. The main thrust of this research is to create a more accessible process by which samples might be cleared for creative reuse.

The current process by which samples are cleared is inaccessible to the public due to prohibitively expensive financial and legal processes, and this has led to a prevalence of illegal sample use online from which musicians, rights holder and producers of sample-based music seldom generate income. Even where tracks contain samples that have been legitimately cleared, those whose creativity is reused often fail to benefit financially. Despite James Brown's 'Funky Drummer' being one of the most sample tracks of all time, drummer Clyde Stubblefield was barely remunerated and "virtually no royalties from these mega-hits have found their way into the hands of the musicians who actually created the music" (Schloz, 2015). While this has historically been the case with paid musicians who are not contractually written into royalty payments, digital technologies such as *Blockchain* do open up possibilities for much more sophisticated automated royalty payments that could feasibly reward many more contributors to creative projects.

Mashupaudio.com went live late in 2016, and has been through a soft launch recently via its first label-related track being made available. Good Soldier Records collaborated with Mashup towards the end of 2016 via a request to promote a track (808 Heartbeat) by one of their artists, Hunter. The soft launch tested the stability and robustness of the key features; a rights holder setting up a new account, uploading some stems and artworks, and then being paid via a transaction. While the track was actually offered via a free promotion, the site appears to have functioned as intended.

The next phase of development, however, is the most intriguing. A shared ambition has been expressed throughout the industry to develop a Global Repertoire Database, although many perceive this as an impossible mission. This would entail a central electronic directory that would record all rights owner data, in order that royalty payments could subsequently be automated. Many perceive Blockchain technology as a possible vehicle for this, perhaps even being the key component, yet an actual working model has yet to be manifest. Development of this will be the aim for the next iteration of Mashup.

## **Sound, curiosity & autism: concepts for the design of inclusive musical instruments for exploratory sonic play - Joe Wright**

Sound is often employed as a powerful tool for engaging young autistic people in participatory performances. However, giving young people with autism chances to choose how to engage, and the opportunity for equal collaboration with typically developing performers continues to be a great challenge for this field of work. Wright's research is a pilot study that aims to develop tools for collaborative sonic exploration with young autistic musicians – musical curiosity instruments. In this presentation, Wright outlines the context and interim findings of his ongoing PhD research. He proposes that curiosity is significant in the actions of experimental musicians and young autistic people alike. Given that experimental music can accommodate diverse groups of performers, developing instruments which encourage curiosity with sound could be a step towards solving the above problems of agency and participation for autistic people.

Early practice-based research is reviewed, detailing how theories of curiosity have been investigated through the design of, and performance with electronic systems for exploratory improvisation. This work has led to some initial concepts for the design of musical curiosity instruments regarding control, cognition, modularity and instability.

From Spring 2017, the research begins to include non-verbal young people on the autistic spectrum in participatory sonic play sessions. Video recordings of these sessions are analysed to gauge participants' responses to prototype instruments. The presentation will conclude with a brief discussion of whether and how these sessions affect the initial design concepts as the research progresses.

## **The 12 bar blues array: how to get guitarists playing solos and code - Chris Payne and Mat Dalgleish**

Technology continues to change the nature of musical performance, with performers using more extensive audiovisual set ups within live shows, and a number of innovative platforms such as the mi.mu Gloves and ReacTable. There is also evidence that, in some instances a least, audience members consider augmentations to the performance experience (e.g. lighting, lasers and multimedia installations) to be as important as the music. However, despite the number and significance of artists exploring these processes, the majority of undergraduate music performance programmes do not cover the artistic and technical prerequisites needed for participation in these areas. This area needs to be more fully considered by academic provision, and a generation of artist-coders developed, if the currently substantial chasm between popular music education and audio/audiovisual coding is to be bridged.

This paper presents the FD Library, a Pure Data visual programming library that aims to get conventional performance and production students coding and performing. This library currently forms a fundamental part of a Music Performance Technologies Foundation Degree programme. Through this library, students with no prior visual programming experience can create digital signal processing devices and/or innovative musical interfaces and instruments. The FD Library adopts a high level abstraction to the following topics: simple sequencing, basic sound generation, graphical principles (basic shape creation, colours, X/Y plots), and a basic use of input devices (mouse/MIDI keyboard/QWERTY keyboard/webcam). Regarding innovative musical applications specifically, the FD Library currently offers the potential for degree students to create sound effects processors, visualisation performance tools (including interactive graphics), implement novel synthesis design mechanisms as well as undertaking original means to encompass human interface devices in performance and instrument design. Fundamentally, the high abstractive nature of the FD Library is enabling the typical music student the chance to enter the coding and performance arenas sequentially. For the purpose of evaluating the library, current student progress with the library has been monitored over a three month period. Initial findings of this longitudinal study are presented, and some possibilities for future work are discussed. Current results are encouraging and thus arguably demonstrate an innovative approach to future undergraduate curriculum design and implementation.

## **The convergence of music, disability & technology - Leon Drake**

Drake Music is the UK's leading organization specialist in the convergence of music, disability and technology. We recognise that society creates barriers that are disabling and therefore prevents many people from realising their creative potential and ambitions. Our expertise lies in the innovative and imaginative use of technologies to remove barriers, collaborating with disabled musicians of all ages to make great music. We want to contribute to, and help to realise, a barrier-free society where disabled and non-disabled musicians of all ages participate, collaborate, create and perform as equals, and where inclusion is the norm.

Drake Music pushes boundaries and challenges attitudes and perceptions through excellent practice and great music, underpinned by revolutionary instrument design. We believe everyone has the right, and the potential, to express themselves creatively through music. We explore, develop and test different ways of working at the intersection of music, disability and technology, breaking new ground in terms of artistic and participatory practice.

To this end, disabled musicians are at the very heart of Drake Music's high-quality, creative processes. As a national provider, we provide school and participatory engagement through to professional support of emerging and established musicians. Our practitioners are innovators, educators, makers, curators and advocates. We aim to be a leading voice in the conversation of 'what is music' and 'what is a musician', challenging the existing cultural norms, which are deeply entrenched. Any music genre - be it classical, rock, folk, jazz - has aesthetics and instrument cultures as to what a 'proper' musician is, what they should look like, and whether or not their instrument is valid. This, by extension, often leads to extreme exclusion for those not able to play a 'conventional' instrument – it's a clique, a club, a tribe.

This paper examines how, through Drake Music's work, the concept of the specialised accessible tool, performance or event is challenged. Instead we are interested in how, in the places where art and technology meet to form the most creatively interesting work, accessibility can be designed in. This allows for the creation of projects, productions and events where cables, sensors and interaction with machines become mainstream, 'normalising' technology in art and creating truly meaningful and aspirational experiences for disabled and non-disabled musicians and audiences alike.

### **The DAWs of perception: producer as improviser - Matt Gooderson & David Sheppard**

Record production as a practice is little more than a century old and responds to societal and technological shifts (Burgess, 2013). The term 'record producer' or, more commonly, 'producer', is an umbrella idiom that can describe a range of different creative practices involved in the making and recording of music. Burgess goes on to divide these practices into six categories: artist, auteur, facilitator, collaborator, enabler and consultant. Broadly speaking, these different articulations define the roles of the producer from overseer to maker.

This live performance seeks to argue for another addition to Burgess's taxonomy; that of the producer as improviser. Through the application of Ableton software in combination with live analogue instrument playing, the performance will contribute to a current of contemporary practice that includes work by fellow improvisational producers such as Tim Exile, Imogen Heap, Brian Eno, Bugge Wesseltoft and Henrik Schwarz.

### **The performance of electronic music - Jenn Kirby**

Music is inherently theatrical, gestural and arguably audio-visual. With instrumental music, a performance can be visualised without being seen. This is largely due to causal listening, whereby the listener is aware of the source causing the sound and therefore is highly likely to visualise that source. The visual associations from acoustically produced sounds do not directly correspond to electronically produced sounds. In the composition of electronic music, a composer often designs an electronic instrument using synthesis methods or manipulated field recordings and therefore is without a causal sound source. This means the performance situation offers new scope for gesture and the creation of an imagined sound source identification based on acoustic and instrumental traditions. What is meant by performance in an instrumental concert is well understood, although what can be considered performance in electronic music is less defined and precisely what this paper aims to address. The use of controllers allows for the creation of a relationship between what the listener sees and hears - or it at least allows for the creation of a symbiotic relationship. Many concerts of electronic music focus on the acousmatic, actively disengaging with the visual, however audio-visual performance elements of electronic music is a growing field that is well supported by the rise of laptop orchestras around the world. This paper presents different perspectives and practices on performance in electronic music with a focus on laptop and laptop orchestra performance.

### **Transforming musical performance: the audience as performer - Adrian York**

Digital technologies have transformed the performance practice, recording and distribution technologies, economy and sonic landscape of music in a process of change that began in the early 1980s. Recent developments in control surfaces, motion tracking electronics, wearable technology and hand-held controllers have opened up the possibility of audiences as well as performers interacting with music in ways hitherto impossible. In this new world sound events can be triggered or manipulated through mapped movement, by means of proximity, via phone apps or gaming controllers to create a more immersive experience for the audience through a creative engagement with the music.

This paper will map my initial research as I explore re-engineering music performance as a collaborative improvisatory space involving the audience who will engage with both programmed, sampled and live music musical artefacts through the use of haptics, proximity and movement controllers using a new generation of interfaces. My research will be looking at a much more engaged and transformative role for the audience than hitherto possible. The position of the audience from a state of alterity to being part of new homogenous entity with the performer. Each performance



then becomes ontogenic, with the audience playing a much fuller and active role than in previous iterations of the performance paradigm.

This is an inter-disciplinary piece of research bringing together elements of human– computer interaction, music composition and improvisation, ethnomusicological studies and situated learning into an interstitial creative space.

### **Translating mixed multichannel electroacoustic music with acoustic soloist to the personal stereophonic listening space: a case study in Jorge Mocada's L'Historia de Nosotros - Simon Hall**

Since the advent of the ADAT and DTRS modular multitrack formats in 1991 and 1993 respectively, and the subsequent first generation of multiple-output audio interfaces, there has been a tendency in acousmatic and other electroacoustically-orientated music for fixed media to move beyond 2-channel stereo towards multichannel masters intended for diffusion into concert hall spaces. 8-channel is now very much a standard for composition within the genre, though this is often mapped onto a non-commercial loudspeaker configuration such as a "Double Diamond" or "French Configuration" ring, a "Main 8" or other setup, as outlined by Wilson and Harrison (2010).

These configurations are not immediately compatible or interchangeable with the film-led standards such as 5.1, 7.1 and its extensions. Therefore, translation of pieces delivered in this manner into a commercial surround or 2-channel stereo version for domestic consumption can be an issue if one wants to try to maintain the spirit, integrity and subtlety of the spatialisation contained within the 8-channel piece as has been composed. This becomes still further complicated if the composer introduces a live acoustic soloist into the equation.

These became central production considerations whilst making a stereo audio CD of Jose Garcia Moncada's L'Historia de Nosotros, an extended 1hour piece for 8-channel electroacoustic "tape" with multi-percussion soloist. The project was a performance, recording and research collaboration between Jorge Gregorio García Moncada (composer) , Federico Demmer Colmenares (Percussionist) and Marcello Zorro (Recording Engineer) from the Music Department of Universidad de los Andes in Bogotá, Colombia; Simon Hall (Producer and Engineer) of Birmingham Conservatoire, UK; and Jonty Harrison (Producer) of Birmingham University, UK to work collectively to produce a recording of the work for release on the Sello Disquero Uniandes record label.

Issues such as phase relationships, balance, and blend between the 8-channels of the tape part on downmix were considered and resolved utilising a Third Order Ambisonic intermediary process. Balance considerations of soloist-accompaniment relationships when dealing with a large percussion setup plus significant, often independent, electroacoustic tape accompaniment, and the practical impact on capture and mix became of paramount importance. Mediation between the composer's intentions, and the practicalities of the media going "into the wild", became important with respect to dynamic range compression and limiting, and the application of artificial acoustic, at both mix and mastering stages.

There is an obvious crossover with some of the dilemmas that are dealt with by audio mixers for cinema preparing downmixed versions of work for broadcast and other home media distribution, but there is also the additional consideration as to how one should treat the performer that is not physically present that goes a stage beyond Eisenberg's (2005) assertion that for the "listener, the performer is not there". The performer, like the tape part, also effectively become "acousmatic" to the final consumer. This raises questions as to how does the listener, or indeed should the listener, differentiate the layers of sound from soloist and the accompaniment in this personal playback situation, and can this ambiguity become an additional creative layer to the overall project.

### **Visual energy and liveness in electronic music - Tim Canfer**

This paper discusses the common problems of a lack of visual energy and liveness in the performance of electronic music. Two factors are examined as the cause of both a lack of liveness and visual energy in electronic music. The first factor is the use of significant non-live elements, which are discussed in the specific context of vocals. The second is the nature and operation of electronic instruments, the necessity for high level control and the visual nature of that control. The concept of liveness is discussed from a performance perspective and a performance model of

liveness is proposed to enable practical analysis. This model explores the categories of live and non-live elements and proposes a state of pseudo-live elements. The different techniques and technologies that drive innovative pseudo-live musical elements are discussed and several ways in which they may be used to convey greater liveness in electronic music are explored.