

The Design of Future Music Technologies: 'Sounding Out' AI, Immersive Experiences & Brain Controlled Interfaces

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ABSTRACT

This paper outlines some of the issues that we will be discussing in the workshop “*The Design of Future Music Technologies: ‘Sounding Out’ AI, Immersive Experiences & Brain Controlled Interfaces.*” Musical creation, performance and consumption is at a crossroads, how will future technologies be affected by exciting and innovative new developments in artificial intelligence, immersive technologies and developing mechanisms for interfacing with music, such as Brain Controlled systems.

In many respects this document acts as a mini survey, made up of supporting material, a bibliography of works and offers a series of quotes from work that has mainly emerged from the FAST Project – see: www.semanticaudio.co.uk.

CCS CONCEPTS

• **Human Centered Computing** → **Collaborative and social computing**; Collaborative and social computing theory, concepts and paradigms; Social content sharing; Collaborative content creation.

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KEYWORDS

Music, Technology, Artificial Intelligence, Brain Controlled, Interfaces, HCI, NIME, Immersive, Virtual Reality, Locative, Art, Design, Agents, Creativity, Performance, Interactive, Ubicomp, IoT, CSCW, Sound, Instruments, Composition, Algorithm.

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Overview

There has been little chance for researchers, performers and designers in the UK to come together in order to explore the use and design of new and evolving technologies for performance. This workshop examines the interplay between people, musical instruments, performance, creativity and emerging technologies. Now, more than ever technology is enabling us to augment the body, develop new ways to play and perform, and augment existing instruments that can span the physical and digital realms. By bringing together performers, artists, designers and researchers we aim to develop new understandings how we might design new performance technologies.

Some Topics that relate to this core theme:

- Methods and Approaches; What are the methods and approaches that we can employ to understanding interaction and interplay in performance and what impact does technology have on this?
- Sonic Augmentation; can performance and sound change the experiential attributes of places, e.g. make them more accessible, more playful & immersive?
- Physical/digital augmentation; how can one augment one's self or existing musical instruments and artifacts physically and digitally?
- Meaning and Mediation; can people narrate or make sense and movement as part of performance – how does the audience understand this?
- Mobility and Immobility; performance and movement, what are the dynamics of performing at rest or whilst mobile, how can technology support co-located and distributed performance and influence reception/performance?
- Locating Content and Spatialisation; how is performance located, how does sound and performance become part of the spatial fabric and what software tools can support this?
- Personalization and Reflection; how can people use new performance technologies to narrate and reflect upon experiences – both as performer and spectator?

These are some tentative areas of discussion and questions that we expect to address in the workshop. The main goal of the workshop is to bring people together to discuss the issues mentioned previously and to explore this emergent space. As part of this conference we would like to build this community and develop a network that would engender ongoing participation, debate, scholarship and collaboration. The workshop would also like to encourage early career researchers and PhD students to attend in order to grow.

This workshop is both relevant to the themes of the workshop and will offer significant understandings of the core themes of Immersion and Emotion. The workshop will bring together a range of people from academics, to industry practitioners and artists in order to fully explore issues relating to interaction, instrument conceptualization and design as well as performance. A key part of these explorations will be to understand new and emerging technologies and the way that they relate to immersion and emotion in music/sound and the role of these, both in respect to the design of such technological systems, and in their relation to performance.

2 Support Materials

In this section we offer quotes from a range of materials to provide a resource for reflection and discussion. This section is divided into

several sections, where we use materials, mostly from the papers and research of the authors.

Bibliographic Materials - This section (*also see*: References) provides links to a series of papers and performances that we hope will be of interest to researchers. It is hoped that these will be of interest to people from a range of research backgrounds and support interdisciplinary research. These reference numbers are provided at the end of each of the preceding each of the following **Material** sections. These relate to the references.

Artificial Intelligence & Robots

“Are the robots really coming...As systems evolve and become more ‘intelligent’ and are able to ‘learn’ it becomes increasingly important to understand how we can interact and engage with such systems, particularly if we as a community are to design better systems that can be used in a creative manner for the composition and performance of music. Research methods such as ethnography can clearly give us insights into creative practices and in so doing raise implications for the design of Human-Like Computing systems. Such studies can provide data that can help to develop and model a useable Computational Creativity Continuum.” [1]

“...a Human-Like Computing approach could work in a variety of contexts within the music domain, which could lead to the development of intelligent plugins. Using intelligent plugins that can support and inform musical practices across software, hardware, platforms and channels offer new and interesting challenges for the development of an Ecology of Audio Technologies that has yet to be realized or fully understood.” [2]

“It might be that audience expectations are different for someone who plays with a robotic prosthetic limb, as compared to other systems where the agency of the system is less obvious, and the audience is unsure of where this lies. Of course, this is to presume that the technology used is not autonomous and has no creative agency in its own right.” [3]

Location-Based Content

“The techniques of musical landscapes and music trajectories enabled for the design, composition and authoring of a locate musical experience that exhibits close and intertwined relationships between the physical and the digital. The flow through the physical park is synchronised with the course of the accompanying soundtrack, at both a high and low level of musical detail.” [4]

“What is the sound of my places? What are my sounds? I know if they aren't there, I notice their removal. Sounds in space are a key feature of space; they are audio landmarks, triggers, markers, relate to people, memories and things. They are an integral part of the landscape, but how do we experience and make sense of a space through sound?” [5], *see* [6] for a discussion on landscape, expressive interfaces and sonification.

Playful Patterns & Platforms

“Community building comes up in a different context amongst DMI designers, whether or not they are part of the academic NIME community...many new instruments are invented each year, but very few of them attract a significant body of performers or repertoire.... Communities of composers and performers can exhibit certain similar dynamics to *maker* communities, including sharing of ideas and building on one another’s results.” [7]

“Digital musical instruments would seem to be a natural vehicle for studying playful interaction within HCI. Most musicians do not aspire to become professionals, and many do not perform in public at all. Rather, the experience of playing an instrument can be its own reward.” [8]

“an accountable artefact – a ‘thing’ that becomes connected to an evolving digital record over its lifetime and that can be interrogated to reveal diverse accounts of its history and use. We anticipate a wide variety of such accounts, from those concerned with conventional IoT issues such as logistics, to practical guidance over usage and maintenance, to formally tracing provenance, to telling personal ‘tales’ of ownership.” [9], also *see* [10] [11] for more pattern-based interaction with the Carolan guitar.

Brain Controlled Interfaces

“The interactive properties of BCI mean it is a tool that is perfect for interaction where continuity needs to be uninterrupted, by using BCI the interactor does not need to stop the film to interact, in fact by using the passive mode of control as earlier described she doesn't even need to be aware that she is steering/controlling the film, its soundtrack and edits. By making these interactive moments ubiquitous, they can happen at any time...and by mixing the music and sound design in predefined combinations the flow of the film is preserved.” [12]

Algorithms

“The Numbers into Notes project, in its first phase, explored how this might have occurred nearly two centuries ago on the giant steam-powered machine using the mathematics of the time. Now we are asking what Lovelace might do today, with a microcontroller instead of the analytical engine. In our experiment, multiple devices are programmed to generate music, with creative interventions by humans to compose and influence the experience in locative sound.” [13], for a video of this work *see* [14] and for use of the “Numbers into Notes” system for composition *see* [15].

Non-Linear Performance

“non-linear interactive performances place particular demands on audiences in terms of appreciating what is going on and ultimately in arriving at some kind of personal interpretation. Our experience from Climb! reveals how supporting audience understanding is a multifaceted challenge that touches upon several aspects of interaction design.” [16]

To understand the technology behind [16], *see* [17], “enabling musicians to compose musical codes that can then be played back during a performance to trigger various interactions. Ideally, these codes can still be recognized even when played back with varying degrees of expression, improvisation and disguise. This notion of musical codes builds on a longstanding tradition of composers playing with musical cryptography.”

Extending Tradition: Opera and Beyond

“opera as an art form is constantly evolving. Composers have never lost their fascination about it and keep exploring with innovative aesthetics, techniques, and modes of expression. New technologies, such as Virtual Reality (VR), Robotics and Artificial Intelligence (AI) are steadily having an impact upon the world of opera. The evolving use of performance-based software such as Ableton Live and Max/MSP has created new and exciting compositional techniques that intertwine theatrical and musical performance” [18], for an overview of an opera-based work in progress *see* [19].

Conclusion

We hope that people will find this document useful and that it will stimulate ideas and discussion. The point of this document was not to give a full and comprehensive list of everything that relates to the topic of the paper, but to be a catalyst to discussion and debate. *See* [20] for an easy to read overview of the project.

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REFERENCES

- [1] Alan Chamberlain (2017) “Are the Robots Coming? Designing for Autonomy & Control in Musical Creativity & Performance.” Audio Mostly 2017: Augmented and Participatory Sound/Music Experiences, 23-26 August. Queen Mary University of London (London, UK) ACM - DOI <https://doi.org/10.1145/3123514.3123568>
- [2] Alan Chamberlain, Alessio Malizia and David De Roure (2017) “An agent on my shoulder: AI, privacy and the application of human-like computing technologies to music creation”, DMRN+ 12, Digital Music Research Network, 19th December, London, UK
- [3] Alan Chamberlain, Kevin R Page, David De Roure, Graham Klyne (2016) Interacting with Robots as Performers and Producers of Music. In: DMRN+11: Digital Music Research Network, December 2016, London
- [4] Alan Chamberlain, Mads Bødker, Adrian Hazzard, David McGookin, David De Roure, Pip Willcox and Konstantinos Papangelis (2017) “Audio Technology and Mobile Human Computer Interaction: From Space and Place, to Social Media, Music, Composition and Creation”, In the International Journal of Mobile Human Computer Interaction (IJMHCI) Volume 9, Issue 4, October - December 2017 pp. 25 - 40. DOI <https://doi.org/10.4018/ijmhci.2017100103>
- [5] Alan Chamberlain, Mads Bødker & Konstantinos Papangelis (2017) “Mapping Media and Meaning: Autoethnography as an approach to designing personal heritage soundscapes” Audio Mostly 2017: Augmented and Participatory Sound/Music Experiences, 23-26 August. Queen Mary University of London (London, UK) ACM - DOI <https://doi.org/10.1145/3123514.3123536>
- [6] Alan Chamberlain, Mads Bødker, David De Roure, Pip Willcox, Iain Emsley, Alessio Malizia (2018) “A Landscape of Design: Interaction, interpretation and the development of expressive interfaces”, HCI 2018 Human-Computer Interaction. Theories, Methods, and Human Issues,

- Lecture Notes in Computer Science (LNCS 10901), Springer.
https://doi.org/10.1007/978-3-319-91238-7_3
- [7] Fabio Morreale, Giulio Moro, Alan Chamberlain, Steve Benford and Andrew McPherson (2017) “Building a Maker Community Around an Open Hardware Platform”. Proc. CHI'17, Denver, USA, 2017. DOI 10.1145/3025453.3026056
 - [8] Andrew McPherson, Alan Chamberlain, Adrian Hazard, Sean McGrath and Steve Benford (2016) “Designing for Exploratory Play with a Hackable Digital Musical Instrument”, Proceedings of Designing Interactive Systems, DIS'16, June 4 - 8, 2016, Brisbane, Australia. ACM Press. DOI: <http://dx.doi.org/10.1145/2901790.2901831>
 - [9] Steve Benford, Adrian Hazzard, Alan Chamberlain, Kevin Glover, Chris Greenhalgh, Liming Xu, Michaela Hoare, Dimitrios Darzentas (2016) “Accountable Artefacts: the Case of the Carolan Guitar”, Proceedings of the Conference on Computer Human Interaction, CHI'16, May 07 - 12, 2016, San Jose, CA, USA, 2016, ACM DOI: <http://dx.doi.org/10.1145/2858036.2858306>
 - [10] Benford S., Hazzard A., Chamberlain A., Xu L. (2015). “Carolan: Augmenting a Guitar with its Digital Footprint.” International Conference on New Interfaces for Musical Expression (NIME 2015), Louisiana, USA.
 - [11] Steve Benford, Adrian Hazzard, Alan Chamberlain, Kevin Glover, Chris Greenhalgh, Liming Xu, Michaela Hoare, Dimitrios Darzentas (2016) “Experiencing the Carolan Guitar”, Proceedings of the Conference on Computer Human Interaction, CHI'16, May 07 - 12, 2016, San Jose, CA, USA, 2016 DOI 10.1145/2851581.2890264
 - [12] Richard Ramchurn, Alan Chamberlain, Steve Benford (2018) “Designing Musical Soundtracks for Brain Controlled Interface (BCI) Systems” in Audio Mostly 2018 - Sound in Immersion and Emotion, 12-14 September, Glyndŵr University, Wrexham, North Wales, UK. ACM Press. <https://doi.org/10.1145/3243274.3243288>
 - [13] David De Roure and Pip Willcox. 2016. Numbers in places: creative interventions in musical space & time. In Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct (MobileHCI '16). ACM, New York, NY, USA, 1059-1063. DOI: <https://doi.org/10.1145/2957265.2964199>
 - [14] Emily Howard and David De Roure. 2015. Turning numbers into notes. In Ada Lovelace Symposium 2015- Celebrating 200 Years of a Computer Visionary (Ada Lovelace Symposium '15). ACM, New York, NY, USA, pages. DOI: <https://doi.org/10.1145/2867731.2867746>
 - [15] Alan Chamberlain, David De Roure and Pip Willcox (2017) “Social music machine: Crowdsourcing for composition & creativity”, DMRN+ 12, Digital Music Research Network, 19th December, London, UK.
 - [16] Steve Benford, Chris Greenhalgh, Adrian Hazzard, Alan Chamberlain, Maria Kallionpää, David M. Weigl, Kevin R. Page and Mengdie Lin (2018) “Designing the Audience Journey through Repeated Experiences” In Proceedings of ACM CHI 2018 - Conference on Human Factors in Computing Systems. Montréal, Canada. April 21st - 26th 2018. DOI - 10.1145/3173574.3174142
 - [17] Chris Greenhalgh, Steve Benford, Adrian Hazard and Alan Chamberlain (2017) “Playing Fast and Loose with Music Recognition”. Proc. CHI'17, Denver, USA, 2017. DOI 10.1145/3025453.3025900
 - [18] Maria Kallionpää, Alan Chamberlain and Hans-Peter Gasselseder (2018) “Under Construction – Contemporary Opera in the Crossroads Between New Aesthetics, Techniques, and Technologies”, in Audio Mostly 2018 - Sound in Immersion and Emotion, 12-14 September, Glyndŵr University, Wrexham, North Wales, UK. ACM Press. <https://doi.org/10.1145/3243274.3243306>
 - [19] Alan Chamberlain, Maria Kallionpää and Steve Benford (2017) “The art and ‘science’ of opera: Composing, staging & designing new forms of interactive theatrical performance”, DMRN+ 12, Digital Music Research Network, 19th December, London, UK
 - [20] Alan Chamberlain, David De Roure, Steve Benford, Chris Greenhalgh and Adrian Hazzard, Maria Kallionpää, David Weigl, Kevin Page and Pip Willcox “FAST forward to the semantics of design for musical performance”, DMRN+ 12, Digital Music Research Network, 19th December, London, UK.