

THE EMERGING ROLE OF THE DYNAMIC MUSIC PRODUCER

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ABSTRACT

Dynamic music is an over-arching term describing music which changes and or adapts to data. This data is central to the composition and/or production of the work. This paper provides a review of terms used to classify a wide range of dynamic music works in order to highlight that music forms are changing along with the tools used to produce them.

Focused research towards artistic approaches of dynamic music making is needed due to the complex nature of developing, composing and distributing dynamic music products. These products usually involve custom-built software and expert interdisciplinary skills. This creates a problem for musicians and the music industry wanting to embrace changes in technology and communication.

The paper suggests solving this problem by investigating a new artistic role called "The Dynamic Music Producer" (DMP) which merges interactive technologies with traditional music making.

1. INTRODUCTION

Popular music making¹ has always embraced new technologies. As music begins to settle in its post digital environment, the full potential of digitization has yet to be realized. Popular music will remain in its ever-changing role reflecting, examining and dissecting the world it encompasses. However, currently the recorded popular music form is still presented as a static artwork based in approaches developed with analogue technologies and awaiting its own transformation. How will the popular music form adapt with the rapidly growing innovation of interactive technologies?

The key aspect of audio is that when it is digitized it can be manipulated. To do this one needs to stop regarding audio as sound and see it for what it really is: data that can be manipulated. (Pfeiffer and Green, 2015)

Over the past 25 years popular music artists have been experimenting with concepts around interactivity, personification, co-creation, reactivity, via CD ROM

¹ Popular music making is defined as the current writing, playing and production of song-based music that appeals to popular (not necessarily mainstream) taste including

releases, album apps, mobile apps, generative music, music video games, websites, media art, sound art, interactive installations and more. However, there are two issues preventing the intersection of interactive technologies and popular music. Firstly, the form of popular music is static and secondly these products usually involve custom-built software and expert interdisciplinary skills.

Karen Collins, 2008 highlights the main obstacle as being popular music's 'limited adaptability.' (Collins, 2008) pg 119) "Games require music to adapt to the gameplay states or player interaction." Popular music is produced for fixed playback and is fixed in form therefore it's placement in a game is limited to titles, credits, cut scenes etc. (Collins, 2008) Given the history of popular music forms and compositions adjusting to suit new technology and audience demands, Collins importantly asks "Might the song structure of popular music soon adjust to the needs of the gaming industry?" (Collins, 2008)

It should be evident that the medieval attitude toward music differed considerably from ours. Neither theorists, composers, nor performers regarded a piece of music as fixed and unchangeable, something to be preserved and always presented in exactly the form given it its first creator. (Hoppin, 1978)

While this quote highlights the perception of music in medieval times it is still relevant today in which game music and interactivity are prominent. Interactive technologies offer artists new tools and opportunities to:

- i. reinvent forms of popular music and
- ii. create immersive worlds to express their stories, ideas and works.

2. BACKGROUND

2.1. Interactive Art

Interactive technologies are however, not solely responsible for the development of interactive art. Interactive art is by no means a new area of expression. There is a rich documented history of artists working within this field. (Kwastek, 2015) Drummond provides an

rock, pop, soul, RnB, reggae, dub, hip hop, indie and EDM.)

important historical overview of interactive sound installations, performance with interactive systems and the design of new instruments from 1970s to the early 2000s. (Drummond, 2009) This important work demonstrates a rich history of artists and the approaches used which in turn have directly influenced the development of interactive music forms.

Sound artists and interactive artists have been developing interactive software and artworks in the media arts discipline since the early 1960s (Sweet, 2015).

2.2. Interactive Technologies

Interactive technologies are vastly different except for the fact that they all produce data or a control input. This data can be mapped onto some kind of audio or sound synthesis parameter. Data could be produced from a variety of sources and interactions including but not limited to; wearables like gestures sensors, body sensors or brain interfaces, mobile phone data from accelerometers or geo-location, body data from one's heartbeat or jogging tempo, social media interaction, Camera or video, Visual interactions within virtual reality, Mouse events, Touch screen.

All of these types of new interactive technologies require the manipulation of data to control a set of mapped parameters. Data mapping becomes central to popular music making or, more precisely, the song-writing and production process.

Many artworks or products outside of the gaming industry utilising interactive data also involve the design of an interactive music work, one must also develop an interactive software system (Drummond, 2009) There are many approaches and techniques to consider when designing a system created to map data to a musical output. This approach involves the expertise of musicians, composers, interaction designers, programmers, software/hardware developers and researchers and that these individual collaborators often play more than one role. (Holland et al. 2013, IAsig 2018)

3. CONTEXTUAL REVIEW

In order to showcase the diverse new work popular musician are producing, a selection of important works and systems are summarised. These utilise techniques across music production based on data. All these works are classified with the terms interactive, reactive, generative, autonomous, responsive, adaptive, algorithmic and contextual. All these terms have been used in a popular music context with no clear relation to finite definitions. The music industry uses buzz words like interactive and dynamic in the marketing of music products and when referring to streaming services like Spotify, Youtube or Pandora, however, the music itself is not interactive or dynamic (changes or adapts to data). For example, an artist may release an interactive app which doesn't include any type of music interaction only social features. Another example could be the term dynamic album, which was used by IFPI 2016 to describe an album

whereby new tracks are introduced over a time span for example a new track every week, again the music itself is still presented in a fixed format. (IFPI, 2016)

A short summary of the work is provided, highlighting artistic concepts, musical content and approach. The works have been organised into 3 sections

- Concept Albums, EPs or Singles, Album Apps and Locative works
- AI, Data Sonification, Autonomous, Algorithmic, Generative
- Systems and Formats

However, there are many crossovers where projects may fit in multiple sections.

3.1. Concept Albums, EPs or Singles and Album Apps

This review is concerned with apps that involve some kind of transformation of the actual music itself by a data input. RJDJ were heavily influential with this concept, with their first popular music release in 2009, 'Little Boots' (Boots, 2009) produced by Robert Thomas as well as 'Love by Air' (Air, 2010). Scott Snibbe, Bjork's collaborator on the 'Biophilia' (Bjork, 2011) app was also influential, producing some interesting and cutting-edge album apps, 'Metric Synthetica' and 'Rework Phillip Glass' Album. Recent releases include, Red Planet, Daisy in the Dark and the browser-based experience Morph in 2016

Other approaches can demonstrate how music can be produced in an album-like form without being fixed in form Bown and Britton 2014, produced an Album with 1000 variations, describing a parametric compositional approach which they define as "the composition of musical elements that contain one or more controllable parameters with which specific instances of the music can be specified." (Bown and Britton, 2014) Locus Interactive Album Concept (Levtov and Adenot) provides a similar approach, "where songs are presented not as individual tracks, but as one continuous body of music, or as a multi-dimensional 'music space' that can be explored non-linearly." (Levtov and Adenot, 2015) One Drop is an amorphous track that can be heard in many ways (Redhead, 2011)

Contextual based works like location and reactive works like The National Mall (Bluebrain, 2011), Fantom, Massive Attack 2016 in collaboration with Robert Thomas and VW & Underworld: Play the Road 2013 in collaboration with Yuli Levto are also examples of how the form of popular music is adapting to interactive technologies whether or not it be via the listeners contextual data.

These approaches demonstrate important new approaches in composition and production methods within a popular music context.

3.2. AI, Data Sonification, Autonomous, Algorithmic, Generative

As AI develops so will possibilities for using it in music production and distribution. Developments in machine learning software like Wekinator, Gesture Follower as well as LibPD and Heavy for Pd integration; give artists new approaches for dealing with and classifying complex data sets.

Generative Music is also growing in popularity, it can also be described as algorithmic or procedural music in some cases. Brian Eno and Peter Chilvers have released a number of generative apps including Bloom¹ in 2008 and 2017. It is a hybrid of an instrument, app, visualizer, generative music device.

Mubert² is an algorithmic, generative Music App that creates and composes music in real-time from a mix of loops..

Magenta was started by 'Google Brain Team' engineers and researchers. This exciting project explores "the role of machine learning in the process of creating art and music." (Magenta 2018) It aims to provide artists and musicians with tools to extend their processes.

GitHub Audio³ represents a GitHub event, (like when an issue is opened or closed, when new code is committed to a repository), with audio and visualizations. The system is based on Bitlisten⁴, published in 2013, which plays audio representing every bitcoin transaction.

GitHub audio and BitListen are interesting examples of how direct data can be used with an interactive audio system to produce audio. Data Sonification is a growing area and these are just two examples of works in this area. Although these examples do not produce popular music as such, the foundation to build upon these generative concepts is highlighted. An example of how these types of projects could be utilised in popular music is a project that has emerged out of the Mubert's system called Miller Future music⁵ project launched in 2018.

3.3. Formats and Systems

WEAV⁶ and Spotify Running⁷ are examples of new formats, contextual-based apps and new music systems, both controlling the tempo of a track. Spotify Running uses mobile sensors to detect the pace of a runner and plays a song at that particular tempo. WEAV adapts the tempo of a song between 100-240 bpm's without affecting the song quality. The system developed by WEAV to compose tracks that adapt in tempo has a unique design. Unlike the track view on a DAW where tracks are

presented horizontally, in Weav tracks are presented vertically. Stems are placed at different tempos, so you have a group of stems at say 80bpm, another group at 120 and another at 160. This allows a composer to visualise the track across tempos. Also, to record different parts for different tempos, resulting in a song that can adjust tempo based on a data input of some kind.

The Bronze format utilises AI based algorithms, which uses stems to generate "infinite permutations of it by fluctuating around a waveform,"(Snapes, 2011) This results in a song with endless ways of being heard. The song changes based on an algorithm so doesn't require any contextual or interactive data from its listener. This could be a game changer in composing music for video games and new music products.

Ninja Jamm⁸ 2012 is a remix app which could be classified as an interactive app and system. The user can download remix packs from artists on the Ninja Tune label. The tracks are provided as 4 loops sets and 1 audio trigger set. The app provides users with a variety of innovative and standard tools to remix the tracks and creating new versions. Yellofier⁹, 2013. was developed by Hakan Lidbo and Boris Blank from band Yello. By moving coloured blocks the user can edit and arrange sounds.

An interesting app Nagual Sense¹⁰ is experimenting with dynamic or interactive composition and like Ninja Jamm is working on a system which the user can pay to download extra music packs to experience. The app allows the listener to compose music through dancing with your phone.

Horizons VR¹¹ 2017 uses Daydream, Google's VR platform to create interactive musical journeys. The app utilises audio-visual experiences to create unique scenes where users can explore and interact in virtual reality. The three scenes in the app include; Outlier including music from Bonobo, Reach including the music of Reuben Cainer, and Empyrean including music from My Panda Shall Fly.

In 2015, Native Instruments released a new format called STEMS open multi-track audio format, aimed at DJ's offering new innovative ways to mix music. STEMS consist of 4 stems "typically drums, bass, vocals and percussion/synths"(McQuaid, 2018). Stems can be played using Native Instruments Traktor Pro 2 which provides a controller for each stem track. Many major dance labels are releasing stem formats of their artists as well as MP3 versions.

¹ <http://www.generativemusic.com/bloom.html>

² <https://www.f6s.com/mubert>

³ <https://github.audio/>

⁴ <http://www.bitlisten.com/>

⁵ <https://en.mfuturemusic.ru/>

⁶ <https://www.weav.io/>

⁷ <https://www.spotify.com/>

⁸ <http://www.ninjammm.com/>

⁹ <https://itunes.apple.com/au/app/yellofier/id622611915?mt=8>

¹⁰ <https://www.nagualsense.com/>

¹¹ <http://reactifymusic.com/portfolio/horizons-vr/>

3.4. Summary

Demand for music influenced by data is developing across all areas of music. This could involve data produced in real-time, some kind of interactive control data or even an autonomous algorithm, machine based in AI or a set of data. All of these types of music works are being created and released at a professional standard. However, they are complex and challenge traditional music making roles.

4. STANDARDISATION

The important work of Toulson, Paterson et al (2016) provides an overview of more recent interactive /album app releases and multi-track formats within the popular music context. The "research looks at the emergent format of the album app and extends existing paradigms of interactive music playback." (Toulson et al. 2016) The chapter focuses on the implementation of mix-stems into an album app structure, it hopes will offer as a model for future formats as the area evolves. The research investigates opportunities for artists based on the capabilities of new technologies and audience responses to their approach. (Toulson et al. 2016) These opportunities are focused on a mix-stem playback with the edition of other artist media like video, images, lyrical content etc, thereby offering an alternative to fixed playback formats like CDs and Vinyl.

Toulson, Paterson et al 2016 conclude, that due to the limited number of album app releases "a unifying format for the future could hold potential benefit before too many variants emerge". (Toulson et al. 2016) Another perspective could be that as with other attempts at standardizing interactive music playback, MXP4 and IM AF, the scope may be limited for artists to experiment with the concepts of dynamic music production discussed throughout this research. These works showcase the cutting-edge approaches available to artists. Perhaps more variants might emerge that push the boundaries of the current proposed standardisation models as more artists experiment with the principles of interactive technologies. More research may offer insight into the authorship of multi-track stems and how this process in itself could offer a richer music form from the artist's perspective. As discussed in a previous paper, developers at the time "seem to be approaching the development from a 'design first and add content later' model. The interface is designed first and then musicians create music for the interface." (Redhead, 2015) "This model and way of thinking needs to be reassessed. A new framework for composing, arranging, producing and recording a work needs to be developed with the output being an amorphous artwork that has many dimensions and ways of being heard." (Redhead 2015) "Instead of the development evolving from an industry and software engineering perspective it needs to work concurrently with how artists perceive their music within a fluid format" (Redhead, 2015)

Stewart, Kudumakis and Sandler, 2011 reviewed potential formats that could help standardise music

embedded with interactivity. "Music is now consumed in interactive applications that allow for the user to directly influence the musical performance. These applications are distributed as games for gaming consoles and applications for mobile devices that currently use proprietary file formats, although standardization organizations have been working to develop an interchangeable format." This review is performed based on karaoke style applications requirements. As these concepts have developed, the requirements have also expanded. The IM AF or the Interactive Music Application Format "integrates multiple audio tracks with appropriate additional information, enabling users to experience various preset mixes and to make their own mixes complying with the interactivity rules imposed by the music composers with the aim of fitting their artistic creation" (Inseon et al. 2011)

Some kind of standardisation could be required for interactive music to reach its potential. Especially given the complexities of income streams, copyright and business models within the music industry. The standardisation of the MIDI and OSC protocol highlight the possibilities when all software can work together, before MIDI was standardised electronic instruments all used different protocols and didn't work together. However, before MIDI became the standard there had been much development and experimentation in the field. The discussed standardisation forms are a good start and will need to adapt with new approaches. As shown in the overview of works produced by artists in recent years a standard could limit a great deal of them, especially examples using a custom audio system like Pure Data (Pd) or an algorithmic and generative approaches. The current version of the IM AF highlights the research problem that popular music is considered fixed. Standardising multi-track recording format offer artists extended formats to realise new works that include artwork and interactive capabilities based on the current form of popular music. This paper, however, is concerned with ways the form of popular music itself could change. An associated standard would need to grow with the needs of artists to be totally flexible in order for the diverse approaches new forms of popular music are undertaking. Standards being developed in the gaming industry could very well offer some extended possibilities for popular music artists.

In 2007 the Interactive Audio Special Interest Group (IASig) released the iXMF format which is used in video games. iXMF is an extension of XML. "For at least forty centuries in all cultures, music has used symbols to represent its contents and give hints for its performance, thus this standard is the continuation of this tradition with its use of human and machine-readable symbols using the XML language." Many authors would like to see this become the standard for all music in video games. "The goal of the IASig in designing this format is to put artistic control into the hands of the artists, to keep programmers from having to make artistic decisions, to eliminate rework for porting to new platforms, and to reduce production time, cost and stress" (Guerraz and Lemordant, 2008)

Gruerraz and Lemordant, 2008 provide an overview of standard formats for game audio and mobile gaming. They define iXMF as “a public standard structured audio file format that supports cross-platform interchange of advanced interactive audio soundtracks” (Guerraz and Lemordant, 2008)

Young predicts that *"The day may not be far off where a composer could take a score's DAW multi-track session, complete with group-bussed stem mixes, individual tracks, effects inserts, automation and dozens of different audio regions, export the session into a single file in the iXMF/Interop format (or equivalent), and then open that file in any give audio middleware and have all the files , tracks, automation and meta-data transfer and open flawlessly"* (Young, 2013)

Traditional music production and game audio software are also showing signs of possible future integration or even merging in their technical capabilities (for example the 2018 acquisition of Max4Live by Ableton), providing a completely new set of composition and production tools for music based in interactive technologies.

The Semantic Music Player, in development, is an important emerging player which utilises mobile devices to play back music that is indeterministic, context-based and interactive. (Thalman, 2016a) Thalman et al, 2016b introduces the Mobile Audio Ontology MAO to define Dynamic Music Objects (DYMO's). This significant work offers a new way to organize and group relationships for dynamic music. MAO is "a Semantic Web framework that investigates new ways in which music can be experienced on mobile devices." (Thalman et al, 2016b) The semantic player would enable a wide range of dynamic music to be experienced without the need to develop a standardized musical architecture and a customized dynamic playback system.

5. DYNAMIC MUSIC DEFINITION

5.1. Variation of Terms

Drummond, 2009 discusses the variation of the term, 'interactive' across the media arts. He describes interactive as an all-encompassing term "that simply implies some sense of audience control or participation in an essentially reactive system." (Drummond, 2009) However, not all systems that respond to input stimuli can be defined as interactive audio systems. An interactive system allows changes in input behaviour to modify the audio behaviour, whereas a reactive system simply plays back static audio events without any adaptation to the user stimulus." (Bajakian et al. 2003) This highlights another confusion of terms, contextual music which incorporates locational music is similar to the game audio definition of adaptive music or Bajakian et al, 2003's definition of reactive music.

Bauer and Waldner, 2013 define reactive music as non-linear which reacts to the listener and or their environment in real-time. They provide examples of what they define as 'adaptive music players' that "select predefined linear

songs from a database based on the user's behaviour (e.g. pace) and/or adjusts the bpm (as far as technically possible such that the song is still okay to listen to). Instead, reactive music is generated in real-time." They cite Andie Nordgren, who defines reactive music in context with the RjDj player "RjDj is a player for reactive music that lets you be a reality jockey - influencing and creating sound in collaboration with pre-written audio scenes that react to the environment in different ways." (Barnard et al. 2009)

There are many examples of location-based apps, context based apps and reactive apps. They all utilise the user's contextual information to influence some kind of music experience, however there is increasing confusion forming with relation to terminology. Levto, who is an innovator of reactive music, describes the three types of Algorithmic music for mass distribution as Generative, Reactive and Interactive. (Levtov, 2018)

Given the confusion across music fields and artists' description of terms used to describe music based on data and or interactive technologies a generalised term could help provide some clarity. This is not to say that any term discussed is not correct, however it can be a confusing area moving forward. Instead of keeping to terminology used across fields the paper investigates the entirety of fields representing music produced by data and suggests the term Dynamic music to describe music that changes or is influenced by data. Figure 5.1 provides a table of terms.

Term	Definition
Interactive	The user controls the interaction, the audio and/or visuals can be controlled in real-time by the direct actions of the user.
Adaptive	Mostly used in gaming and is defined as non-linear music. The music is composed to adapt and takes form to support the game-play and actions of the user.
Autonomous	System led music, the music works independently of user direction. This could include, generative, AI compositions and systems.
Reactive	Context based on and reacting to data or the environment in which the data stream is constantly updated.
Responsive /Contextual	The music adapts to the user's environment or actions (not direct actions). The system uses the user's contextual data to influence the playback of the music, for example location, weather, heartbeat etc.
Generative	music is created by a system and is ever changing.
Algorithmic	generating music using mathematical approaches for example markov chains, stochastic

	algorithms, automata and fourier analysis.
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Table 1. Table of Terms for Dynamic music systems.

5.2. Dynamic Music

Dynamic music is an overarching term that is used to describe a variety of different approaches. Collin's defines "dynamic audio as audio, that is changeable". (Karen 2008) Kaae defines Dynamic music as "music which is in some way able to react to game-play, and or is in some way composed or put together in real time by the computer." (It is an all-encompassing term describing all types of music which change. The change of the music is influenced by input data. This could include game audio, interactive art and computer music resulting in data being central to the composition and/or production of the work. Control/Input data, or for that matter any type of data, is used to transform the form, structure, organisation of sound material, creation of sound material and/or the overall mix of the work.

In a game audio context, dynamic music is "a broad concept that encompasses both interactive and adaptive audio. It is audio that reacts both to changes in the gameplay environment and/or in response to the player." (Collins 2008) Collin's highlights the renowned game composer of the Super Mario series, Koji Kondo's four components of composing dynamic music (Collins 2008)

1. the ability to create music that changes with each play-through;
2. the ability to create a multi-coloured production by transforming themes in the same composition;
3. the ability to add new surprises and increase gameplay enjoyment; and
4. the ability to add musical elements as gameplay features." (Kondo 2007)

By extending the term dynamic music to include all music areas as well as new experiences developing as highlighted in the contextual review, the four components outlined above by Kondo require significant broadening.

Given the interdisciplinary skills involved in creating dynamic music works and products from the composition through to playback and distribution, this paper proposes the creation of a new role in popular music making the Dynamic Music Producer. This role would help bridge the gap between static and nonlinear works, complex data mapping and audience interaction.

6. FINDINGS AND CONCLUSION

Throughout this paper it can be shown that recorded music forms are changing along with the tools used to produce it. The current forms of popular music making could not only hold back innovation but risk becoming dated. Song-writing and production processes need to adapt to dynamic music forms for popular music to realize its potential of embracing interactive technologies and beyond. As tools continue to develop standard approaches to dynamic music production, artists will have endless

opportunities to explore new music forms. The review of works and discussions unpack the complexities of developing music systems, integrating these music systems into dynamic music systems, the mapping of data and finally composing in a dynamic setting.

Artists and scholars use different terms to describe their work. It is for this reason the term dynamic music is used as an attempt to simplify the field and describe any of the interactive music approaches in single and hybrid form. By defining a new style of music new roles can be developed to help create future music works and products.

As the popular music form starts to merge into a dynamic form, the skills required challenge traditional roles in popular music making. Even within a gaming context Collins concludes, "[t]hese approaches require new ways of thinking about music and will require new software tools and teaching methods to accommodate them." (Collins, 2008) In the context of popular music production, a role dealing with the composition and production of interactive products is yet undefined in academic literature as well as within the music industry. However, throughout the contextual review it is clear a new artist role is emerging. Robert Thomas, Yuli Levtoy and Hakan Lidbo are just some examples of cutting-edge musicians and artists working in a new role that brings a unique set of skills. Each of them calls themselves something a little different, Adaptive Music Producer, Reactive Music Producer and an Interactive Music Producer, respectively. The works they have produced provide examples of very different approaches and playback systems, all of which could be grouped with the term dynamic music

Dynamic music will continue to grow in popularity as software, tools and standards develop for the composition and playback of music that can adapt to data. This paper calls for further discussion on the framework, evaluation and components of the dynamic music form and the emerging role of the Dynamic Music Producer.

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