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This paper was presented at the 149th Convention of the Audio Engineering Society, as eBrief:460. The full published version can be found at

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## Interactive Recorded Music: Past, Present and Future

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### ABSTRACT

This Engineering Brief charts the story of user-interactivity with recorded music. Audio technologies and creative compositional techniques are discussed with particular regard to scenarios where creativity has driven the demand for technological advance, and vice-versa, where technical advance has enabled new creative-practice approaches. This is contextualized through discussion of relevant implementation in legacy systems, mobile applications, video games, artificial intelligence, and extended realities. In identifying seminal applications of music interactivity from the past and linking them to present capabilities and practices, future trajectories for interactive recorded music are extrapolated.

### 1 Introduction

Interactivity with music takes many forms, particularly in the performance realm. However, the opportunities for recorded music to become interactive are rapidly increasing given new and emerging technologies for digital audio.

The mobile app has been deployed to give the user new modes of control over music playback [1]. Whilst some interactive features are tactile and active, app designers have also implemented geolocation and biofeedback data to influence music composition and playback. Binaural algorithms allow music and audio playback to modify in real-time given a listener's positioning in a virtual-reality (VR) space; object-oriented audio platforms can be utilized to allow music listeners the ability to manipulate the content and balance of musical components; equally, video game audio engines enable musical passages to be adapted, looped and reconstructed in real-time dependent on different gameplay scenarios. In the near future, these technologies may converge, offering further new musical experiences that are yet to be anticipated.

Although such playback technologies are very much the current zeitgeist, some of their principles are derived from compositional techniques up to 100 years old. Interacting with recorded music is nothing new for the consumer either; for example, amplifier tone controls and variable-speed turntables have allowed basic mediation since their inception.

This engineering brief summarizes the story of interaction with recorded music. Audio technologies and creative compositional techniques are discussed with particular focus on scenarios where creativity has driven the demand for technological advance, and vice-versa, where technical advance has enabled new creative practice approaches.

### 2 Defining Interactive Recorded Music

The term Interactive Recorded Music (IRM) is worthy of definition in the context herein. There are numerous approaches to interacting with music, and this is implicit in its creation; however, once a music track (or at least its component stems) have been 'printed' in a traditional recording process, it can be considered fixed, such that the music will always play back with the same sonic characteristics.

Despite this, artists, DJs and listeners have for many years been intrigued to play back recorded music 'not as the artist intended' – mediating recorded music to create new interpretations. Furthermore, digital tools enable recorded music to be 'unmixed' or remixed in the playback device (to varying degrees of success) and hence precipitate new forms of interaction. Examples of IRM therefore include:

- Recorded music that allows the listener to manipulate musical or technical aspects of the playback
- Playback of recorded music that might autonomously vary on each listen

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(adaptive/dynamic music are terms that might overlap here)

- The results of reappropriation after elements of recorded music is made openly available to listener, producer, artist or DJ

Although not an exhaustive list of interactive possibilities, here, these three forms are considered particularly pertinent to chart the past, present and future of IRM.

### 3 Manipulating performance playback

Before interactive recording and playback were substantially possible, composer Percy Grainger created innovative orchestra pieces such as *Random Round* in the 1920s [2]. In this, Grainger introduced an element of chance to performances; individual vocalists and instrumentalists were empowered to make random choices from a menu of variations of the score. This piece showed Grainger's *intention* for the music to play back differently on each occasion, so, to the audience, it sounded unique every time.

Reliable playback of recorded music became possible with phonographic machines in the late 19<sup>th</sup> Century, but the pitch of the performance was mechanically related to playback speed. Composers subsequently embraced and explored this relationship, as exemplified by John Cage in his 1939 piece, *Imaginary Landscape No.1*. The piece is scored for four performers who play a muted piano and cymbal, as well as two performers controlling variable-speed turntables with amplifiers [3]. The result was predictably a heterodox to the 'musically trained' ear since there was conscious disregard for established tonality and tuning. The principle is important however, in that (amongst other things) it demonstrated a curiosity towards temporal manipulation in pre-recorded audio as a compositional device.

Manipulation of recorded music was taken to new levels of expression by the reggae sound system DJs in Jamaica in the 1950s and 60s, who had developed techniques to use equalization and other effects as they played back records, in order to accentuate particular aspects of a recording [4]. Osbourne

Ruddock (a.k.a. King Tubby) elaborated on these techniques by a number of methods; using faders and mute controls on a mixing desk to bring elements of the track in and out of the mix, and by patching auxiliary sends and group busses on a mixing desk to dynamically alter the amount of a given signal sent to an effects unit such as a delay or reverb.

DJs might also utilize the frequency-sweep controls to cut & boost the desk's EQ to continuously alter the timbre of a track, or dynamically alter the parameters on effects units, such as the feedback level or delay time on a delay unit. In 1975, hip-hop DJ Grand Wizard Theodore is said to have accidentally discovered the vinyl scratching technique, when a DJ manually moves the record back and forth whilst it plays – a sound that has become defining and ubiquitous in some music genres [5]. Furthermore, the concept of the 'mashup' performance describes the playback of two records that are in similar key and tempo at the same time, enabling DJs to blend or multiplex between passages of two songs in a unique and spontaneous fashion.

Digital technologies have been developed to simplify and mimic such DJ techniques that would require very niche skills to implement with vinyl turntables. For example, the Native Instruments (NI) *Traktor* software was launched in 2000 and became recognized as the first digital DJ sync-tool. The *Traktor DJ iPad* app was released in 2014 and, in 2015, NI released *Stems*, a DJ tool that offers manipulation of four separate tracks, packaged in a MPEG-4 Container [6]. The *Stems* system works with *Traktor* software, and also includes a content management system that allows musicians to create and package their own material for subsequent manipulation in a live performance environment.

### 4 Multitrack releases

In 2004, Jay Z officially released an entirely a capella version of *The Black Album*, to encourage remixers to interact with his content and use his vocals with new musical material. Controversially, a (then) unknown remixer, Danger Mouse, chose to mash up *The Black Album* with unauthorized instrumental samples from The Beatles' *The White*

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*Album*. The result was called *The Grey Album*, which became a huge (illegal) Internet success [7]. Soon after, in 2005, Trent Reznor of Nine Inch Nails chose to release full multitrack files of the band's commercial releases, so that listeners could process and engage with the music in a novel manner [8].

Since then, bands such as Radiohead (in 2008) have followed suite, and such multitrack audio has become a valuable arts resource for both creative experimentation with music, and for teaching and learning in songwriting and music production.

## 5 Album Apps

With the increasing ubiquity and processing power of smartphones, the *Album App* format emerged [9]. Björk released her *Biophilia* album as an app in 2011, which can be purchased and downloaded to iPhone and iPad devices and incorporates a number of unique graphics and interactivity features. Alongside music, artwork, credits and animations, the app also introduces interactive elements for some songs, allowing the user to manipulate different aspects of the sound. Similarly, Peter Gabriel's *MusicTiles* app, although not an album itself, allows users to interact with the music and produce unique (albeit basic) mixes of the tracks, and is designed to be more of a game than a playback medium.

Gwilym Gold's *Tender Metal* Album App (released in 2012) used a novel algorithmic system to play back a unique synthesized composition on each rendition, without the need for any user control. The *BRONZE* engine that powers *Tender Metal* was developed at Goldsmiths, University of London in 2012 [10], and was deployed again in 2016 to play the 24-hour-long *Route One* by Sigur Ros – without it ever repeating. Bernhoft's *Islander* album was released in 2014 as a 2 GB app, incorporating remix and stem-based audio, including interactive features that allowed the listener to manipulate the balance and panning of instrument stems, and to experiment with looping motifs and phrases from the songs [11]. 2015 saw the *oiid* format launch, which not only allowed volume and panning of stems, but also provided play-along chords and scrolling lyrics. This was soon followed in 2016 by Massive Attack's, *Fantom* which remixes songs according to data

gathered from device sensors, including the camera, clock, microphone and the user's heart rate [12].

Other stem-player app-based formats include *8Stem* and *Ninja Jamm*, both of which offer extensive sonic manipulation possibilities (typical of music-production workflows with simplified interfaces) albeit requiring significant user engagement, with 'named artists' providing content.

## 6 Alternative media

In 1993, Todd Rundgren released *No World Order*, which was the world's first interactive album – hosted on CD-i. This system offered users control over tempo, mood and playback direction, amongst other things, with content overseen by several eminent producers. Music performance games such as *Guitar Hero* (2005) and *Rock Band* (2007) proved very popular and although the result was music, gaming was the core ethos with control coming from hardware controllers that, in part, emulated real instruments. Scores were awarded dependent on how close the player came to the original performance. The 2010 *Bopler* was another IRM game – a web-based system that allowed remixing of tracks with a gamified interface and a social media slant.

In fact, video games have been deploying interactive music since 1981; a game called *Frogger* is generally credited with being the first instance of 'adaptive music' by triggering an abrupt musical change in response to a 'game call' – a trigger signal derived from the user's interaction with the game. Since then, two principal modes of IRM have become commonplace: vertical re-orchestration, in which instrumental layers are dynamically added or removed according to game state, and horizontal re-sequencing in which blocks of music are shuffled along the time line, again in response to user activity.

VR applications offer several modes of interactivity, from hand-gesture, with/without controllers to gaze. An accelerometer, magnetometer and gyroscope combination in a typical head-mounted display can generate a scalar to manipulate a *B-format* ambisonic signal before it is decoded, thus facilitating dynamic audio panning relative to the

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user's head movement. Whilst the music does not necessarily change in response to this, its spatialization does, and this represents a legitimate mode of interactivity.

VR games sometimes utilise IRM. *Jam Studio VR* offers a number of 3-D models of instruments, and the player can trigger phrases that synchronize with a backing track. The concept is that each trigger gesture plays a different phrase, which gives the impression of performance complexity, but the source phrases are long, and the player typically triggers a shorter component section. Google's *Musical Forest* allows user-placement of sound-generating icons in horizontal surround, and *Song Exploder Presents: Inside Music* plays song stems in spatial audio. *Riff VR* is a virtual 'Rock Band', with animations that prompt the player which area of a 3-D model to interact with along with rhythmical cues.

The 2018 *Beat Sabre* requires players to chop flying blocks 'in time' to trigger musical components in an EDM style. *TheWaveVR* emerged in 2017, providing a flexible and sophisticated DJ-esque conceptual-control environment, and in 2018, attracted Imogen Heap to stream a live performance using it.

## 7 variPlay

The *variPlay* mobile-app platform was first launched in 2015 with an innovative Album App *The Red Planet EP* for artist Daisy and The Dark, allowing music fans to explore the building blocks and creative vision of different versions of a song or album [1][13]. The *variPlay* app allows real-time interaction with many different remixes, for example moving smoothly between a pop-radio mix, EDM, or acoustic versions of a song. A unique automated interface also allows the listener to step back from the app (passive engagement) and listen to the song as it takes an algorithmic journey through different remixes. *variPlay* also includes rich media content, incorporating animations, artwork, lyrics, production credits and social media links, allowing the listener to explore the artist's creative world while listening along to their music.

A major benefit of *variPlay* is that it allows data mining of listener preferences that are not captured

by other download or streaming music platforms. For example, app analytics enable data about listener preferences with respect to genre and engagement with musical components and structure to be correlated against fan demographics, and can subsequently be used to inform future touring, release and artist-development strategies.

More recently, in 2018, the *variPlay* platform has been utilized to produce interactive Album Apps for a number of other music artists, for example independent UK artists Defabl (featuring Vanessa Knight), and also major-label artists including Mexico's Ximena Sariñana who is signed to Warner Bros. At present the *variPlay* platform is being tested as part of an on-going project funded by the UK Arts and Humanities Research Council to explore potential commercial opportunities and business models for interactive music apps, including direct purchase products, in-app purchases models, free products used for enhancing fan engagement, and as a corporate branding platform.

## 8 The future

It is anticipated that as user-interaction systems evolve towards hand/face gestural recognition and eye-tracking control, intuitive musical interaction will become the norm. The nascent area of haptic feedback is acknowledged as being essential for immersiveness, and never more so than when exerting musical control. Semantic encoding of musical components will make them increasingly searchable, accessible and deployable, and systems to combine and control these components will emerge. Resynthesis will allow complete juxtaposition of sonic fingerprints to allow any instrument or person to sound like any other. Artificial intelligence is also powering increasingly sophisticated adaptability, and augmented reality will strive to become the major disruptive technology for productivity and recreation. Object-based audio reassembles the sonic artefact from components and metadata at the point of delivery, according to playback medium or user preference. At present, it is primarily a tool of broadcast, but will increasingly evolve to offer musically creative options. Of course, all these technologies will

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converge, bringing new requirements and opportunities for interactive music.

## 9 Conclusions

IRM brings new opportunities for engaging fans and listeners with recorded content, and has the potential to generate new types of exposure or revenue streams for artists. Many past and current implementations of IRM are overtly gamified, demanding user attention and presenting an interface that distracts from core musical content – an experience of the interface. If the age-old aesthetic of ‘passive’ musical enjoyment is to be retained across (or despite) so many modes of alternative delivery then designers must first acknowledge, and then respond to this.

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