

The Distant Landscape

Exploring factors in binaural composition for headphones

Commentary

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Introduction

“I now regard the spatiality of acousmatic music as the most original and striking aspect of its identity.”

Denis Smalley, 2014 (CIRMMT)

This research explores composition for the binaural medium and builds on previous coursework submitted towards this degree¹, additional findings of which are summarised in appendix 1. The portfolio is realised using virtual instruments and scores are included only for analysis.

Recorded music is commonly experienced via headphones, and while some have suggested that music production practices have begun to reflect this trend (Kopf, 2019), loudspeaker playback remains the dominant force shaping production (Rumsey & McCormick, 2021:116,146). Loudspeaker stereophonic images rely on left-right crosstalk absent in headphone reproduction (Roginska, 2018:91) creating a very different, often internal, spatial impression². Absence of crosstalk does, however, present an opportunity to trigger our binaural perception, creating an immersive spatial impression much closer to acoustic audition than the typical 60° stereo loudspeaker image³. This is analogous to presentation of stereoscopic images on a virtual reality (VR) headset; binaural production represents the auditory equivalent⁴.

Much 'beyond-stereo' spatialised acousmatic music exists, essentially intended for loudspeaker playback⁵. Loudspeakers and headphones have inverse spatial strengths and weaknesses (see appendix 2). Accordingly, some engineers creating spatial mixes for

¹ Auld (2020, 2021a, 2021b, 2021c).

² Headphones also bypass the unique, profound and internalised colouration imparted by our body, especially our pinnae. This personal aural fingerprint, our Head-Related Transfer Function (HRTF), remains a major focus of research.

³ And only slightly more even if venturing beyond standard image stability and mono-compatibility.

⁴ Whereas auditioning conventional 'loudspeaker' stereo on headphones may be thought of as equivalent to viewing the same image with each eye at close range.

⁵ For instance, Smalley's spatial taxonomy specifically excludes headphones (2007:43).

surround-sound or periphonic⁶ systems craft separate binaural versions (Cornell, 2021). Moreover, Natasha Barrett, a leading voice in spatial composition reveals the tension between writing *for* the medium and *independently of it* (2022:178-9), acknowledging the many considerations applying to ambisonics (ibid.:178-186). Consequently, this thesis investigates binaural music composition specifically for headphones⁷.

Research Questions

Within the context of digital composition for the binaural medium⁸:

- How might various approaches to spatial source-listener arrangement, acoustic parameters, and immersion contribute to compositional relevance and effectiveness?
- How can stereophonic sources and binaural field recordings be employed in synthetic spatialisation?
- What are the current practicalities, challenges and shortcomings?

Case study

Inspiration and approach

The Distant Landscape evokes an imagined night-time journey along a woodland path, partly a response to lockdown and the idea that we may have the ability to ease or even transcend confinement through imagination and meditative practice. The landscape in question is

⁶ 'With height', rather than horizontal-plane-only (Gerzon, 1973).

⁷ Binaural reproduction via crosstalk-cancelled loudspeakers is not examined here.

⁸ Static (non-head-tracked) and pre-rendered (generalised rather than personalised HRTF), but directly synthesized (not via ambisonic coding or virtualised loudspeaker arrays).

largely inspired by the imagined Pacific Northwest of America as depicted in media such as David Lynch's *Twin Peaks* (1990-1), suggested by 'indie folk' groups such as Fleet Foxes in their eponymous album (2008), and the pioneering fantasy video game *The Legend of Zelda: Breath of the Wild* (Nintendo, 2017) (fig.1)⁹.



Fig.1 Scenery from *Zelda: Breath of the Wild* (Nintendo, 2017)

The game's performed score features traditional eastern instrumentation and accordion echoed in Canons 3(ii) and (iii) respectively. Moreover, strikingly effective minimalist modal piano compositions accompany exploration of the game's extensive 'open world' (8-bit Music Theory, 2017). Images derived from this and similar anime-influenced games appear in numerous 'Zelda & chill'-style online videos, underscored by a sub-genre of jazz-influenced music often termed 'lo-fi beats'¹⁰, are typically categorised as promoting relaxation or concentration. Perpetual live-streams, exemplified by channels like Lofi Girl and its supportive community (2022; Alemoru, 2018), long popular, are plausibly claimed to have risen in popularity in response to the pandemic lockdown (Alexander, 2020). The piece was also influenced by the work of minimalist Reich¹¹.

⁹ Nintendo has acknowledged *Twin Peaks*' influence on the *Zelda* series (Lane, 2019).

¹⁰ One example released after this work's draft submission depicts remarkably similar themes: a night-time woodland journey, fantasy creatures, lake and canyon (Riot Games Music, 2021).

¹¹ Through his association with canons (Reich, 2002:5), mallet textures and jazz guitarist Metheny (Cooke, 2017:107,213,243-245), himself an earlier influence alongside keyboardist Mays via *Still Life (Talking)* 1987).

Aside from the compositional inspiration, I broadly experimented with the spatial medium itself, aiming to touch upon various genres and approaches. The textures employed draw on psychoacoustics, for instance avoiding spatialised low frequencies and considering transient perception (Blauert & Braasch, 2020; Ziemer, 2020). From the outset, especially with the pandemic in mind, realisation via virtual instruments was envisaged. This also allowed control of what Smalley terms bonded space (2007:38-9) with all virtual instruments modified to approximate anechoic recording, eschewing effects almost entirely. Physically-modelled synthesis was found especially appropriate for this work¹². Previous assessment had selected IRCAM SPAT Revolution (Flux::SE, 2022) for spatialisation under REAPER DAW control (Cockos Inc., 2022).

The introduction features an edited binaural recording of the Nottingham Council House quarter chimes (fig.2) that have influenced the piece, captured from my work room.



Fig.2 Cambridge Quarters

The four-note motif appearing throughout the piece is, I believe, a subconscious response to hearing the chimes some 20,000 times since moving here¹³, and is almost bar three in retrograde (fig.3).



Fig.3 Central motif

Inharmonic bell-like timbres are a theme, perhaps also stemming from the metallic scraping of the tram and its bell.

Having assembled a wearable binaural microphone and successfully captured the chimes, I recorded locations resembling the imagined scenes. Woodland north of Nottingham

¹² Being potentially fully anechoic, transient- and partial-rich therefore aiding auditory localisation.

¹³ The chimes ring quarter-hourly from 7:45 to 10:30; 60 times per day.

provided material for the first two transitions and Creswell Crag¹⁴ for subsequent sections. The harmonic language is inspired by Bill Evans' impressionistic post-bop jazz voicings (Pamies, 2021) together with use of the pentatonic; some basic harmonic analysis is noted. The aim was to include more accessible styles generally not addressed by acousmatic music. I found composition within sequencer 'piano roll' useful for generating some types of musical material, especially because the chromatic presentation does not imply tonality; rather it is internalised and determined intuitively. My acceptance of dissonance was greater than when writing at the piano, echoing the inharmonicity inherent in the bells and bell-like timbres which influenced the piece.

I later discovered that what emerged stylistically from a partly non-instrumental approach to writing *Gorge* was ground previously covered by Brian Eno¹⁵, indeed, that Eno and Rob Thomas had lately collaborated on *Pavilion Music*, a spatialised work featuring choral textures and a wooded setting (Thomas, 2022). Whereas early Nancarrow canons explore pitch (Gann, 1995:xi,11-12), they almost always include intervallic offset (ibid.:64-7)¹⁶; here only simple canons at unison feature. Nevertheless, his 'experimentalist' approach (ibid.:3-4) is echoed here.

Discussion

The Distant Landscape comprises *Gorge*, *Woods*, *Lake* and *Reflection*; four movements representing the mental journey, interspersed with field recordings (fig.4). These interludes link each movement, setting the scene before fading out in order to avoid detracting from or clashing with the synthetic spatialisation, or complicating the assessment of its effectiveness¹⁷. The longer fade in *Gorge* conveys the gradual shift between worlds. Each self-contained movement illustrates specific techniques that demonstrate the medium's potential, hopefully creating an innovative response to compositionally embedded binaural spatialisation (figs.5,6).

¹⁴ An ancient landscape featuring a limestone gorge, woods, a stream and small lake (Creswell Crag, 2022).

¹⁵ In *Through Hollow Lands* (1977).

¹⁶ Later abandoning pitch for tempo canons.

¹⁷ Given the recording's bonded space, differing HRTF and potentially complex influence, respectively.

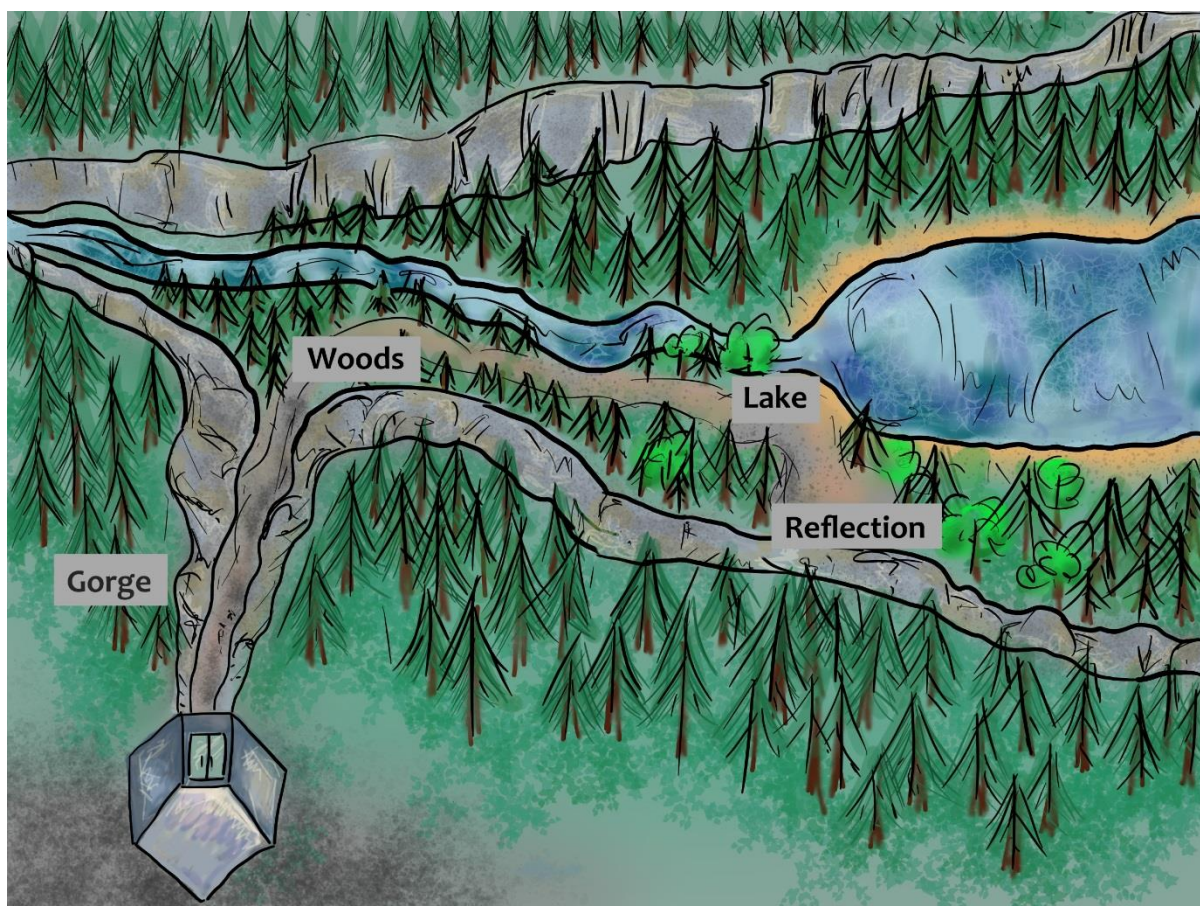


Fig.4 Plan showing the imagined journey in *The Distant Landscape*

	- Gorge -			----- Woods -----					- Lake -			----- Reflection -----		
	- intro -		-transition-	Canon 1	Canon 2	Canon 3(i)	(ii)	(iii)	-transition-	-transition-		Canon 1	Canon 2	Canon 3
listener motion vel	1	0	0(1-2)	3	3	3-0	3	3-0	3	0	0	0	0	0
source motion vel	0	~0	0	0	0	0	0	0	0	0	1	1	~1	~1
acoustic 'size'	0	1	1 - 3	2	1	2	2-	2+	2+	2	1	2	2+	1 - 3
immersion	0	3	1 - 3	1	1	2	2-3	2-3	2-3	1	1	2	3	1 1 3 2
sources/layers:														
recorded bin(r)	(r)		(r)	(s)	(s)	(s)	(s)	(s)	(r)	(s)	(r)	(s)	(s)	s
synthesized (s)		(s)		(s)	(s)	(s)	(s)	(s)		(s)		(s)	(s)	(s)

Fig.5 Technique overview (see appendix 3 for expanded version)

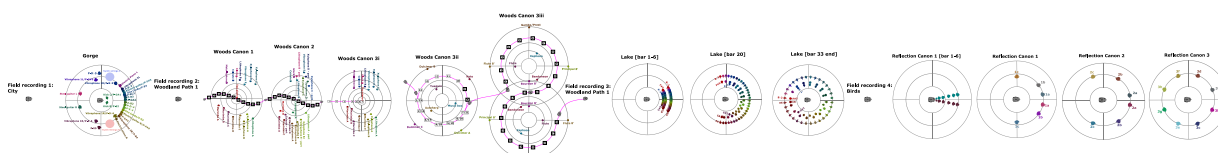


Fig.6 Spatial overview (zoomable)

Gorge

The piece opens with a performed¹⁸ binaural transition towards an open window overlooking a city street. The hour chimes are then heard, followed by the great bell and opening piano motif, the room tone and narrowly spatialised stereo image of which suggest the domestic setting. The following section represents the journey's first stage, initially through a narrow rocky gorge which progressively widens. The aim is something mysterious, while slightly solemn. From a metrical kick drum opening, representing steps, the chimes are embodied by a subtle echoed vibraphone ostinato in a high register. Following practitioner advice, the pitch-height effect¹⁹ is exploited, and low frequencies kept fairly central (Lord, 2020; Smalley, 2007). Nevertheless, the slight L/R offset of alternate drumbeats implies steps. Harmonic clusters on electric piano and a second vibraphone (fig.7) hopefully impart some ambiguity while references to Americana in the guitar tones²⁰ add to modal harmonies reminiscent of Fleet Foxes²¹.



Fig.7 Harmonic clusters in *Gorge*

¹⁸ In that I shaped and timed my approach.

¹⁹ Where pitch is perceptually correlated with elevation.

²⁰ Undistorted baritone Telecaster and steel guitar (Doyle, 2005:1, 113, 123-4, 173).

²¹ I later discovered that Fleet Foxes' songwriter Pecknold, shares similar goals ("...transportative music that has [...] an ethereal or other-worldly quality...") (2021:13m31s) and modal approach (ibid.:18m44s).

The tempo ($\text{♩} = 80$) is intended to suggest a very relaxed walk or hypnagogic²² amble, based on measurements of my own walking pace.

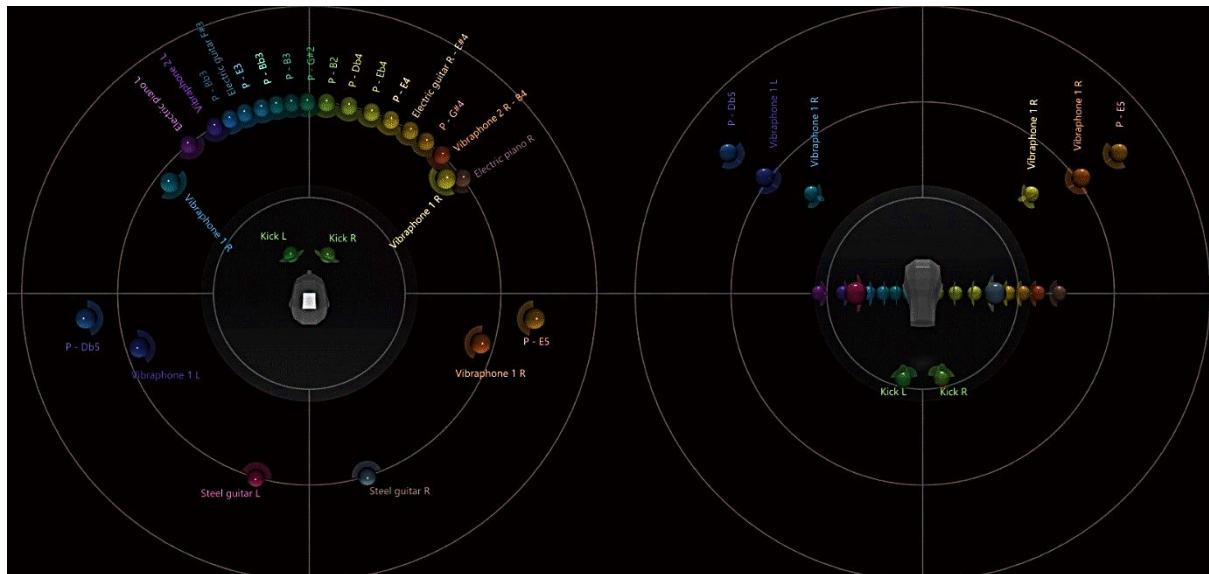


Fig.8 *Gorge* source spatialisation

Rather than spatialise stereo from each instrument, a better spatial impression resulted from instruments being duplicated in left/right pairs (fig.8), and then assigned separate chordal or melodic notes. Despite static source placement, some phrases appear to traverse the image in three stages through source switching, with L/R unison notes appearing central. Conversely, a synthesized ‘pad’ was directly overlaid in stereo, with its image initially narrowed using mid-side processing to avoid undermining the binaural impression. After many experiments variously dividing the piano part between multiple virtual pianos, a single *una corda* instrument was selected and each pitch spatialised to a separate location. This differs from Werner et al.’s detailed spread of *melodic* lines (2020:14) which I found distracting in that context (Auld, 2021a). The other significant spatial factor is the gradual change in acoustic, implying the increased space of the widening gorge (fig.9). Of note are the more rapid size changes employed to produce an immersive wash of reverberation or chorus between passages.

²² Between wake and sleep (Doyle, 2005:131).

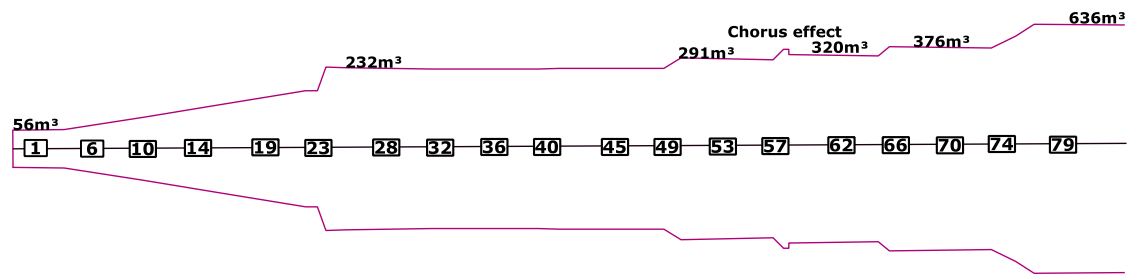


Fig.9 Automation of acoustic in *Gorge*

Woods

A binaural recording from a landscape matching the envisaged forest path (fig.10) provides a transition into the following movement, *Woods*, where the imagined path meanders through woodland.



Fig.10 Sherwood Pines – field recording location for *Woods*

Sources are placed in groups of notional trees that the listener passes between, similar to *Test-9v* and *Test-11-1h* (see appendix 8), and the approach to generating the musical

material via canons was triggered by participation in Early Music meetings²³. The four-note motif was set in 6/4 for versatility, and a series of three canons written in (moderately) voice-leading polyphony (appendix 4).

Sixteen virtual instruments were selected for Canons 1, 2 and 3(i), placed in progressively ‘larger’ acoustics²⁴, representing woodland of increasing maturity and sparsity (fig.11). They also feature timbral progression from wood through stone/glass to metal, the latter echoing the timbres of the opening chimes. Research indicates that percussion instruments with a strong initial transient and harmonic complexity are easily localised (Wenzel et al., 2018:18).

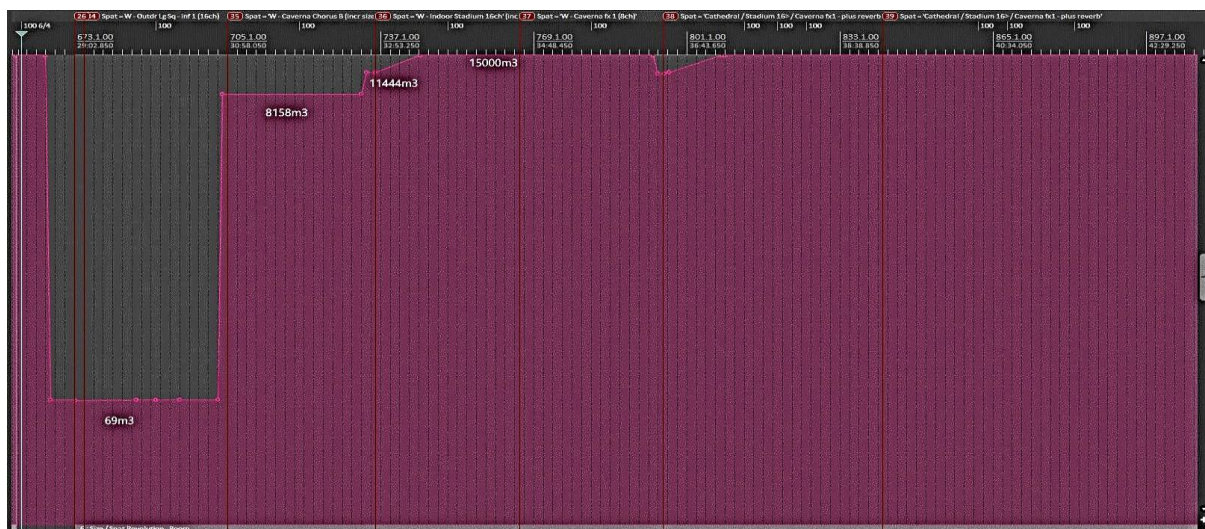


Fig.11 Changes in acoustic during *Woods*

Like the piano in *Gorge*, the six-part Canon 1 [6:28] is spatialised with the arrayed instruments each playing a dedicated pitch²⁵ while the listener traverses the scene (fig.12). Timbral arrangement is by pitch, with the most harmonically rich instruments assigned the lowest notes and so forth. This parallels James Tenney's *In a Large, Open Space* (1994), where listeners *freely* wander among twelve spatially distributed musicians, though they perform slowly evolving harmonics rather than melodic pitches (Gottschalk, 2016:np). The effect is, however, similar to the slowed canons of *Reflection*. Canon 2 [7:07], also six parts, overlays the ‘pitch’ approach with a ‘part’ one in which each instrument (in timbral

²³ Convened by Henry Parkes and Nicholas Baragwanath; discussing and singing, for instance, Purcell catches. Having planned to write counterpoint parts for each spatial source, experiencing live, spatially spread canons provided inspiration.

²⁴ i.e. acoustics of greater spatial volume etc.

²⁵ Effectively the *klangfarbenmelodie* technique, though here employed to aid auditory localisation of each source as a separate entity (Wenzel et al., 2018).

sequence from wood to metal) also plays the entire canon once. Again, the listener follows a serpentine path though the instruments (fig.13).

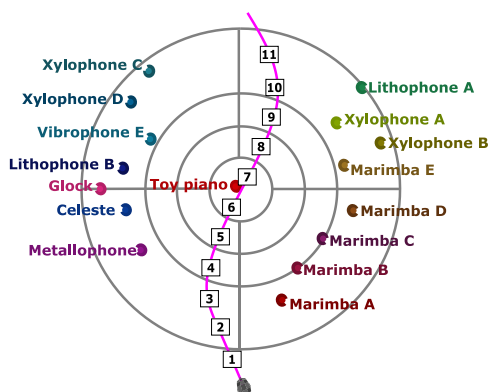


Fig.12 Canon 1 spatial arrangement

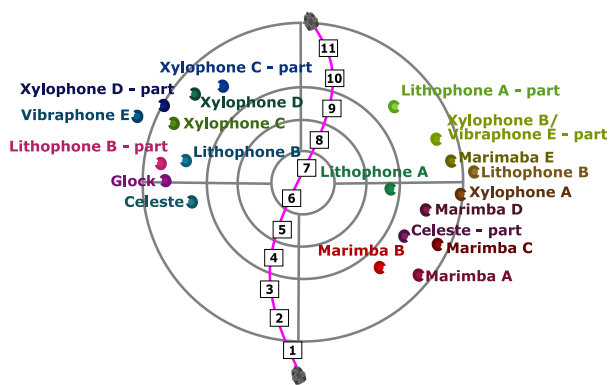


Fig.13 Canon 2 spatial arrangement

Canon 3(i) [7:47] again employs the combination of 'pitch' and 'part', but with all sixteen instruments playing the seven parts in full, producing a carillon-like finale. The listener approaches the array from a distance before gradually halting in its centre (fig.14).

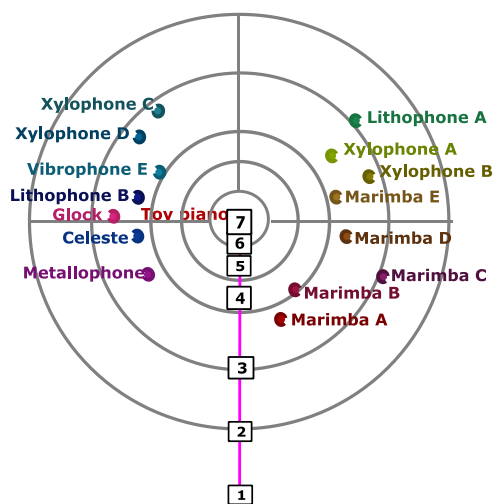


Fig.14 Canon 3(i) spatial arrangement

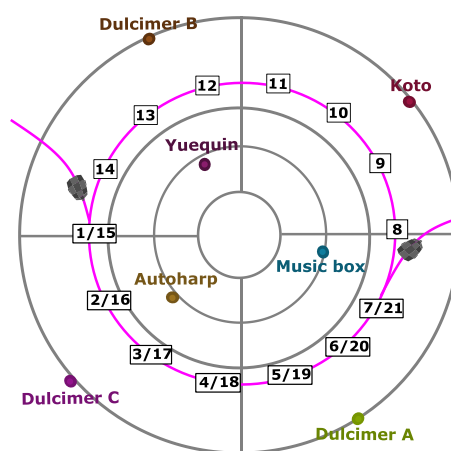


Fig.15 Canon 3(ii) spatial arrangement

Canon 3 is twice more rendered in part-only form, firstly 3(ii) using mainly stringed instruments with the listener moving counter-clockwise among them [9:06] (fig.15) and secondly, 3(iii) with aerophones [10:18] (fig.16). In the latter, the listener initially moves clockwise, then counter-clockwise from the mid-point [10:57] with each part muted in

reverse order of introduction. This instrumentation hopefully lends a fairy-tale atmosphere, matching the wooded setting.

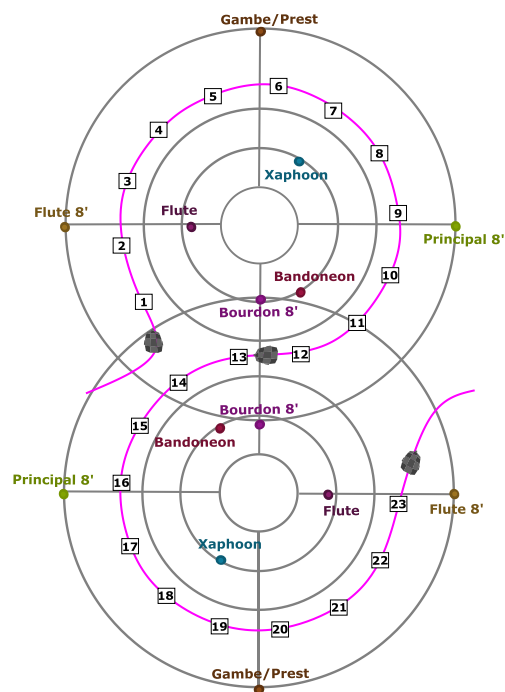


Fig.16 Canon 3(iii) spatial arrangement

Lake

A second woodland path recording transitions to the third section, *Lake*, effectively a coda in which the motif is variously harmonized. Here, I was much inspired by the patterns made by waterfowl on Creswell Crags lake: not radial ripples, but V-shaped wakes. I attempted to reflect these patterns in the writing (fig.17)²⁶.

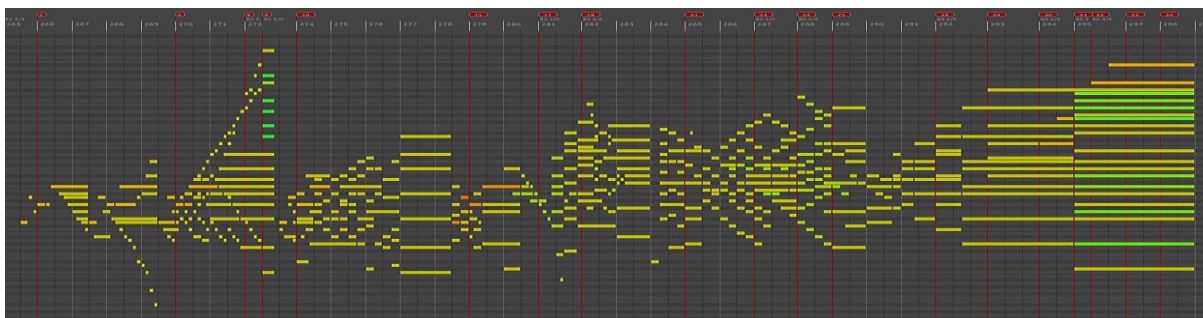
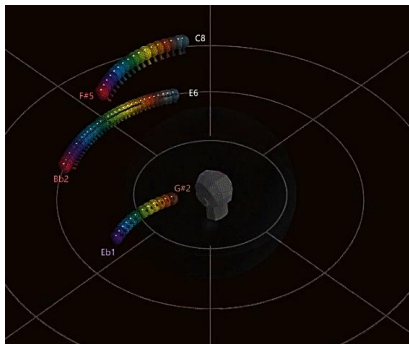
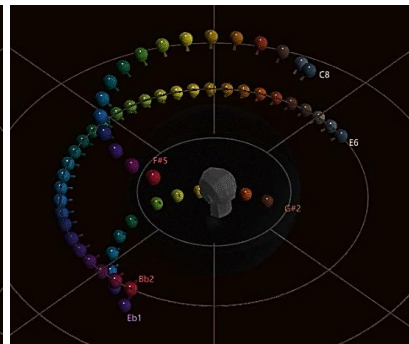
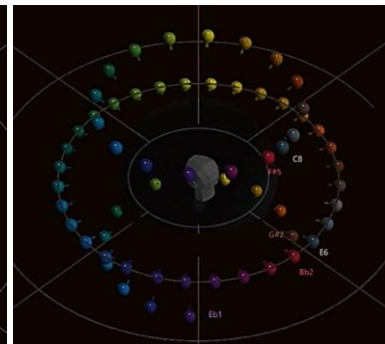


Fig.17 *Lake* draft working

²⁶ Interestingly, Nancarrow rejected a graphic pitch approach (Gann, 1995:31-2).

In keeping with this compositional method and the clockwork theme, the piece is reproduced as if by player-piano and with limited dynamics²⁷ rather than by performer. Like *Gorge*, the piece explores a binaural approach to the piano but in greater depth. A similar pitch–location assignment was made, but here, each note is given a unique location, with no sharing. The 32 central pitches are placed at head height, with higher pitches elevated and the bass pitches lowered. In contrast to *Gorge*, the placement expands during the piece, with an initial 60° spread until bar six (fig.18a) linearly increasing to 360° by bar 33 (fig.18c). Room size also increases towards the end of the piece to enhance the sense of immersion. A spatially processed version of the stereo piano track was added to the final bars producing a subtle organ-like effect. The aim here was not to highlight the spatialisation but allow it to emerge as the piece develops.

Fig.18a *Lake* bars 1-6Fig.18b *Lake* bar 20Fig.18c *Lake* bar 33

Reflection

A final field recording featuring bird calls which effectively ‘illuminate’ the reverberant space of Creswell Crags lake, leads to *Reflection*, a durational, textural work with detailed separation answering the call for slow, subtle, minimalism common among practitioners (Smalley, 2007:37). It features a gradually evolving texture, suggesting a slowly expanding sound stage. The piece is influenced by the Japanese practice of ‘forest bathing’²⁸, and the theory that we may experience lower cognitive load in woodland, due to partial auditory

²⁷ Also echoing Nancarrow (Gann, 1995:29).

²⁸ The restorative Shinrin'yoku (森林浴) (Studio Ion, 2020).

adaption to this environment (Blessner & Salter, 2007:337). It also presents contrasting spatial images, representing internal and external voices, and the states of mind and visualisation techniques described by Fehmi and Robbins (2008:36-9,170-1).

The sonic material derives from versions of Canons 1-3 featured in *Woods*, heavily processed. Variations of the first two canons were created by changing the part order, altering the harmony either side of the fully polyphonic bar (see appendix 5). Combining these 'a' and 'b' versions increased the final sense of space. Additionally, Canon 3 was expanded to ten parts to extend the bell-like timbre and transposed with the aim of producing a more uplifting effect.

The process resulted from many preparatory experiments applying various combinations of resonance, reverberation and pitch/time processing before spatialisation. Some of these revealed textural layers and the process was refined to enhance these as described below. The three canons were then rendered with a harmonically rich sawtooth synthesizer tone; one instrument playing each part in full. The panned stereo from each canon (1a, 1b, 2a, 2b and 3) was then processed first with resonant reverberation, then resonance-free room simulation and finally naturalistic reverberation. Repeating this using five resonance variations yielded five stereo files per canon. These were combined, slowed to quarter speed and pitch-raised a tritone.

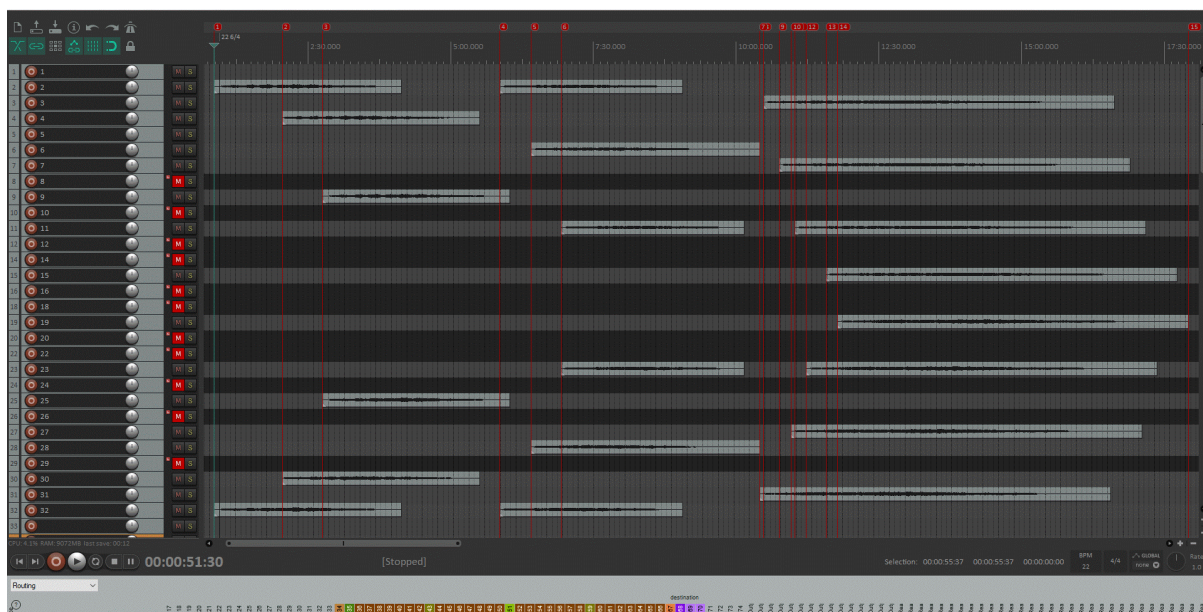


Fig.19 Spatialisation timing of processed canons in *Reflection*

The resulting five processed canons were subsequently spatialised in three sections (fig.19). In the first section, Canon 1a is initially heard in mono with both left and right signals collocated within the head, representing an inner voice. The sources then gradually shift towards narrow stereo positions before the listener (fig.20a), after which other layers are added at increasingly wide spacings (fig.20b). Specifically, Canon 1b is placed at $\pm 23^\circ$, and a further elevated copy of Canon 1a ('1c'), with a 180° spread then beginning (fig.20c). The emphasis leaves the frontal position and the sensation becomes increasingly wide.

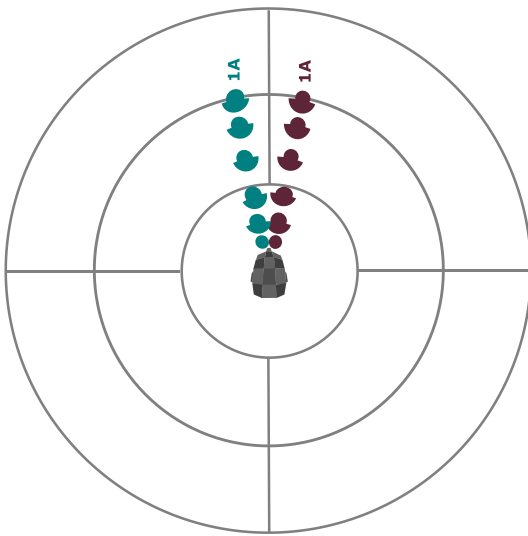


Fig.20a *Reflection* part 1, bars 1-6

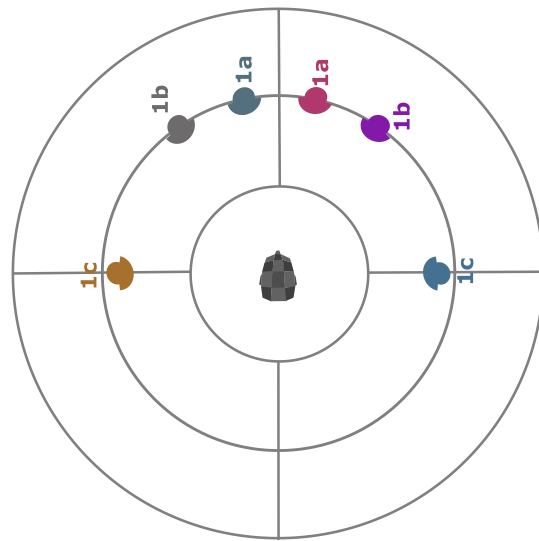


Fig.20b *Reflection* part 1, bars 6-19

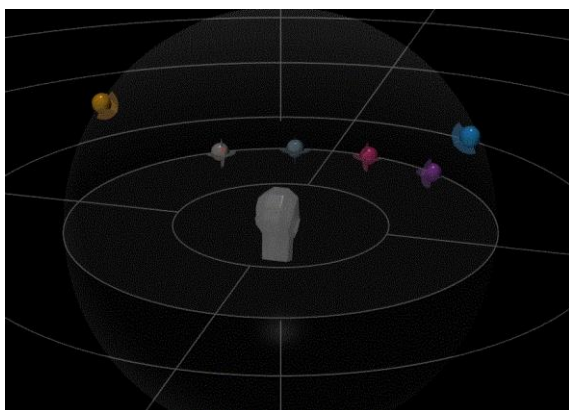
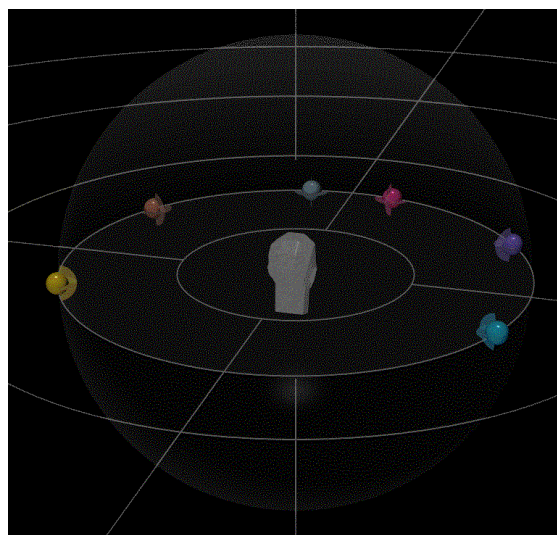


Fig.20c *Reflection* part 1, oblique view

The closing phrase of Canon 1 provides a V-I cadence into Canon 2 [18:39] which opens with Canon 2a presented at the same initial spread as Canon 1 (fig.21a,b).

Fig.21a *Reflection* part 2, plan viewFig.21b *Reflection* part 2, oblique view

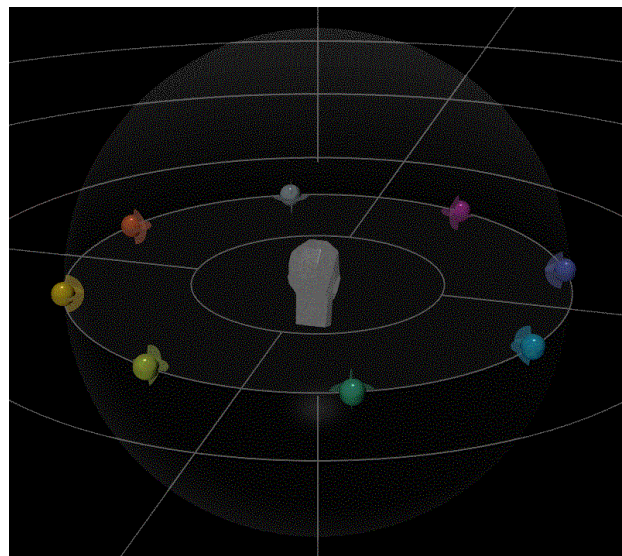
A wider Canon 2b is then added, followed by a further iteration of Canon 2a('2c') introducing sound beyond 180°. The relatively dry treatment of Canons 1 and 2 seems appropriate to something representing outdoor meditation, especially given that the source material brings its own bonded space, albeit at quarter speed.

An instrumental overlay [21:21] provides a harmonic bridge into the final section, Canon 3 [23:12] (fig.22a,b). The Japanese *shō* (笙) was chosen for its extended timbre (Kapusinski & Rose, 2022) and a sample instrument²⁹ selected; despite its natural beauty, stereo reverberation was required to blend the transition. The modulation's texture echoes the opening passages of Takemitsu's *In an Autumn Garden* (1973) and *Ceremonial - An Autumn Ode* (1992), both featuring *shō* and purposefully spatialised forces (Burt, 2001:162), the latter including bell chimes, and harmonic clusters (ibid.:224).

²⁹ Also extending the instrument's range and allowing chromatic modulation to a remote key.

Fig.22a *Reflection* part 2 into modulationFig.22b *Reflection* modulation into part 3

Canon 3 is rendered with an encompassing spatial presentation (fig.23a,b), and with each layer slightly L/R-delayed, considerably enhancing the spatial effect. 3-D reverberation is then introduced, with the room size and related parameters increased throughout the section (fig.24), inspired by Fehmi and Robbins' description of an ever-increasing scale of spatial awareness (2008:37) and perfectly resonating with Oliveros' account of 'global attention' within meditative Deep Listening (in Gottschalk, 2016:np(4.1)). *Reflection's* reverberation stops short of the vast immersion of Oliveros associate Stuart Dempster's *Morning Light* and *Cloud Landings* (1995) though mainly due to time constraints.

Fig.23a *Reflection* part 3, plan viewFig.23b *Reflection* part 3, oblique view

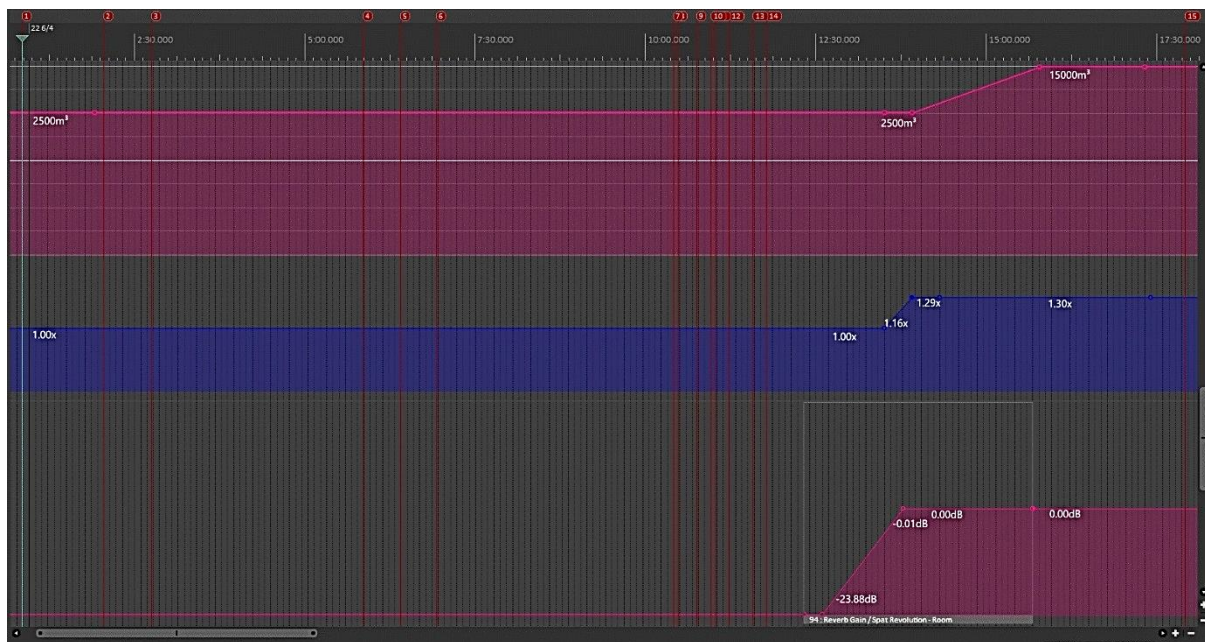


Fig.24 *Reflection* – automation of acoustic parameters

Critical reflection

Each section of the work showcases a different set of techniques, with varying success. While *Reflection* and *Gorge* feature largely static sources and are perhaps the most successful, *Lake* and *Woods* include listener-source movement and do not seem as engaging. In particular, I feel that in *Woods*, my expectations for what could (currently) be achieved were excessive. *Gorge* initially employed the most ambitious listener-source motion in the work: a route exceeding 100m with some 3000 automation items dynamically relocating all 32 available sources bar-by-bar. The intention was that the listener would perceive themselves passing the array of instruments at a realistic walking speed. I was eventually forced to concede defeat; despite altering the number of sources, their distance and all acoustic parameters, there was no sense of movement, only a series of awkwardly changing dynamics that clashed with any musical arrangement I could contrive. Loudness can be an important localisation cue, but while realistically rendered moving sources may boost perception of direction, they also produce level variations, something cited by Werner et al. and now of clear significance (2020:6). A subsequent attempt employed a circular array of sources that gradually moved to the rear, intended to imply progress. Even this

proved problematic³⁰, inconvenient and ultimately unnecessary; the final presentation uses static sources.

In *Woods*, I again possibly fell victim to inflated expectations, the result may underline pitfalls inherent in writing for a specific technology. Surprisingly perhaps, the technique of combining ‘pitch’ and ‘part’ locations seemed effective. Previous experiments layered a marimba-like vibraphone under each transient note to add sustain, perhaps supporting the musicality alongside the localisation, and resonating with Zagorski-Thomas’ concept of Sonic Cartoons (2014:49)³¹. In these artistically led works, I was unable to produce anything approaching the sense of movement I perceive in preparatory experiments (such as *Test-12-1u*, see appendix 8) despite similarly dedicating a single location to each note. The only exceptions are the two instrumental versions of Canon 3(ii) and (iii), which seem to me relatively fresh, unusual and promising. Note that although these represent a conceptually serpentine path, I again found that a simplified circular arrangement avoided complex listener automation, source repositioning and level-timbre variations.

The widely varying effectiveness of spatialised melodic or chordal material exceeds that suggested by insights drawn from auditory research, for instance Bregman (1990). The melodic L–C–R panning employed in *Gorge* initially seemed comically prominent and inartistic, but as the arrangement progressed, those elements felt apt and welcome. The success of these techniques is likely highly context-dependent.

Having previously defined four pillars of binaural realism³², I would now add a fifth; that of general plausibility. Although some movement does seem apparent in *Woods*, particularly in the instrumental renderings of Canon 3, my own perception, and that of others³³, judges that it is the *sources* that are moving, not the listener³⁴. This is entirely reasonable, given the sensory voting mechanism described by DeSalle among others (2018:160-71), and correlates with results from the initial version of *Gorge*. Though not strongly engaging, the dynamic

³⁰ Causing timbral shifts.

³¹ Deliberate sonic exaggeration to guide the listener’s perception.

³² Personalised HRTF, head-tracking, plausibly accurate acoustics, reproduction fidelity (including personalised headphone compensation), (Auld, 2021c).

³³ Via informal feedback.

³⁴ Perhaps, serendipitously, evoking a band of wandering minstrels.

immersion featured in *Lake* seems reasonably effective and the discrete pitch–location assignment, also in *Gorge*, perhaps deserves further exploration.

Production software synthesizing binaural audio is nascent, with the feature often promoted only as a means of previewing loudspeaker reproduction. Numerous technical problems were encountered some of which could not be overcome (see appendix 6). Exploration of binaural composition is currently a significant logistical undertaking. Technical distractions easily dulled my creativity and put me further from what Csikszentmihalyi calls a ‘flow state’ than I can recall having been during composition (2016:173). Simply *defining* spatial placement and automation is an issue, as is consistent monitoring. One conspicuous absence is a means of entering spatial coordinates³⁵ into a piano roll note sequencer in the same way that MIDI velocity and expression controllers may be defined. I found it helpful to predefine various spatial arrays in SPAT and address them via a 32-channel DAW sub-bus, thus easing experimentation. An opportunity seemingly exists to create affordable hardware and software tools for those working in this field.

Obtaining usable recordings was challenging, mainly due to human activity: vehicles, alarms, appliances and occasionally aircraft³⁶. Wind noise was also prominent as were incidental noises from clothes and anything physically contacting the miniature microphone leads. Mannequin head recordings seemed entirely lacking, presumably due to unrealistic pinnae. Conversely, I found recordings made at my ears far more effective than much of the literature suggests, supporting observations made by long-standing binaural practitioner Dallas Simpson (University of Derby, 2019). In some circumstances, the results are stunningly realistic, and I regret not experimenting from the outset.

These findings highlight potential HRTF mismatch. Some factors may seem irrelevant technicalities, but the ability to hear spatial effects necessarily impacts spatial composition. I found that within SPAT, one HRTF setting produced only a clear *frontal* image and another only a clear *rear* image, with the default, generalised choice reproducing both front and rear images but with only middling realism. Elevation is apparent in my recordings but absent when synthesised using a generic HRTF. HRTF personalisation or crosstalk-cancelled

³⁵ Both polar and Cartesian.

³⁶ See appendix 9 for example noise removal.

loudspeaker reproduction may overcome these issues (both at significant cost). More generally, the benefits conferred by headphones in terms of greater transient detail are counteracted by difficulty in judging tonal balance and loudness.

Addressing the more successful pieces, *Gorge* seems to produce an effective sense of immersion and an expanding, perhaps cinematic acoustic that supports the conceptual journey in a way difficult to achieve in stereo. I feel that the opening of *Reflection* makes good use of the intimate proximity only practical with headphones. The contrast between this and the subsequently increasing immersion, beyond that possible in stereo, adds to the effectiveness and the overall transition to a meditative ambience. The many layers apparent in this slowly evolving piece, the orchestral and tremulous choral effect that emerged, did so because of the spatial processing. The pre-processing spatial resonance, binaural placement and simulated immersive acoustic all contributed to the effect, allowing the layers to be discerned.

Although the two more successful pieces share a lack of source–listener movement, Lord and Werner et al. both employ highly effective motion in their work (Dali's Deathmask, 2019; Jack Hooley, 2019a). The latter combines this with prominent and engaging dynamic contrast between internal, monaural sound and expansive ambisonic treatment. The common factor may therefore be a genre better able to accommodate an experimental approach. Several experimental electronica pieces planned for this work were discarded due to stylistic clash, portfolio duration constraints or because I realised that they were not truly conceived with spatiality in mind.

The changes in acoustic during the piece were initially envisaged as realistic transitions. It soon became apparent that the sense of realism could be easily undermined by rapid parameter changes, due to sound energy stored in the system, the results approximating the effect of altering echo unit delay time. Like its conventional equivalent, these effects hold creative potential, particularly because they operate in definable three-dimensional space. Oddly, the manufacturer does not promote this feature.

Although binaural audio is often considered unsuitable for post-processing, requiring all equalisation and compression to be applied prior to spatialisation, I found unexpected creative scope for post-manipulation. Basic transforms such as L/R swaps naturally mirror

the spatial image³⁷, but surprising latitude exists for overlaying binaural recordings. Overlaying 'pitch' and 'part' renders created with differing acoustics was found optimal for Canons 2 and 3(i), supporting the argument for perception over accuracy. Rare, 'clean' sections of field recordings were duplicated, thereby extending transitions. Additionally, the 'figure-8' spatialisation of Canon 3(iii) was created without repositioning sources or complex automation simply by crossfading between two renders with reversed listener direction. Stereo sources with compatible images may also be layered with binaural audio without compromising the overall image. Some striking delay effects can result from duplicating binaural renders of moving sources, effectively creating a trail of copies. Conversely, such initially convenient post-processing complicates compositional changes or render variations, for instance with differing HRTFs or ambisonic orders.

³⁷ Assuming sufficiently symmetrical listener HRTF.

Summary of findings

The binaural medium exhibits a high degree of context-sensitivity, favouring a heuristic approach. Focusing on perception rather than acoustic accuracy is valid and was found superior, likewise the purely conceptual journey over (simulated) literal motion in *Gorge*. Similarly, optimal layering of differing acoustics, for example in *Woods*, was very much experimentally determined.

As is commonly suggested, spatialisation, applied with limited artistic intent has potential to underwhelm. Simply surrounding the listener with sources does not guarantee effective work. While psychoacoustic insights such as the value of anechoic sources are noteworthy, source-listener motion, often recommended to aid localisation, may be problematic due to loudness and timbre variations; effective results are possible without it. Conversely, motion can be compelling, though intended *listener* motion is easily perceived as unintended *source* motion, though not always, something perhaps worthy of investigation. Immersion is a highly significant, potentially independent attribute and compositional resource, benefiting from versatile 3-D reverberation. Although experimental music may be suited to the medium, acoustic instrumentation can work well, perhaps due to timbral familiarity.

Stereo sources may be incorporated with relative ease as virtual source pairs and, with care, even directly layered in some contexts, enhancing rather than undermining binaural presentation. Binaural recording, while not without its issues, is worthwhile; it can elucidate and frame the medium's characteristics, also contributing valuable inspiration and potential material. Binaural audio is readily spliced, layered and even duplicated with time offset to produce delay effects. Similarly, spatialisation software has seemingly untapped potential for creative effects and *détournement*³⁸.

Significant technical issues remain, such as ambiguous imaging, especially for height, as well as profound 'workflow' impediments to binaural composition. While it is important to keep spatialisation in mind, the ability to anticipate its effects through experience allows some preparation in stereo, helping to offset the current inertia of binaural technology. HRTF mismatch makes second opinions invaluable, nevertheless, the static, non-personalised binaural medium can be effective and is valid for artistic exploration. Finally, simple canons can provide a rich source of material for spatial composition, especially when pre-processed to produce emergent, interpretable detail, further enhanced by binaural spatialisation.

³⁸ Creative misuse (Keep, 2005).

Conclusion

“...it means that everyone can do it; and that's what I want - that's how this format will become commercially successful.”

Jocelyn Lord, 2018 (University of Derby)

Given the popularity of headphones, there is much potential in writing for the binaural medium rather than conventional, 'flat' stereophony. It offers a unique resource that warrants an approach dictated neither by the constraints of ambisonics nor multi-channel loudspeaker arrays. Nevertheless, existing literature often fails to escape the gravitational pull of acousmatic reproduction³⁹.

Current binaural sound brings its own considerations, for instance potentially ambiguous directionality and a weak, elevated frontal image but scope evidently exists for effective work. Advances have apparently already improved the binaural experience over what practitioner Andrew Sheron termed “a dusty window” (SonicScoop, 2016).

At present, the medium lacks the consistency of loudspeaker formats, though if technical progress continues, likely given commercial and societal factors⁴⁰, binaural sound may well provide a canvas at least as versatile as other spatial approaches, and certainly a more democratic one.

Future work could further investigate the emergent character of *Reflection's* pre-processed⁴¹ spatialisation, compositional binaural data sonification, the meditative benefits of immersive binaural soundscapes, the potential of object-based work and increased binaural fidelity (allowing, for instance, meaningful exploration of height) or conversely creative misuse, and could even pursue convenient, accurate and affordable tools for composition, further supporting Lord's prescient call for widespread experimentation.

³⁹ e.g. Barrett (2022:177).

⁴⁰ Initiatives such as Sony 360 Reality Audio, Apple AirPods Pro and MPEG-H have, already begun to address methods of enhancing binaural realism via, respectively, HRTF customisation, head-tracking and plausible acoustics; Inglis suggests that even Dolby's lauded Atmos binaural renderer may sound 'flat' versus Genelec's latest system (2022a).

⁴¹ Via resonance/speed/pitch.

Bibliography

8-bit Music Theory, (2017), 'Breath of the Wild Soundtrack Analysis PART 1 of 4: Hyrule Field Theme', [Online] Available at: <https://www.youtube.com/watch?v=tl-6K3zrcr0&t=78s> (accessed 10/8/22).

Agrawal, S. Simon, A. Bech, S. Bæntsen, K. and Forchhammer, S. (2020), 'Defining Immersion: Literature Review and Implications for Research on Audiovisual Experiences', *J. Audio Eng. Soc.*, vol. 68, no. 6, pp. 404-417. [Online] Available at: <https://doi.org/10.17743/jaes.2020.0039> (accessed 10/8/22).

Alemoru, K. 2018, 'Inside YouTube's calming 'Lofi Hip Hop Radio to Relax/Study to' community' [Online] Available at: <https://www.dazeddigital.com/music/article/40366/1/youtube-lo-fi-hip-hop-study-relax-24-7-livestream-scene>, (accessed 10/8/22).

Alexander, J. 2020, 'Lo-fi beats to quarantine to are booming on YouTube' [Online] Available at: <https://www.theverge.com/2020/4/20/21222294/lofi-chillhop-youtube-productivity-community-views-subscribers>, (accessed 10/8/22).

Askerøi, E. (2013), 'Reading Pop Production: Sonic Markers and Musical Identity' (doctoral dissertation). University of Agder, Kristiansand.

Auld, M. (2020), 'How can spatial popular music production practices best exploit binaural playback?', MA Research Proposal.

Auld, M. (2021a), 'Critical assessment of recent approaches to binaural production – a cursory study of practice and technical factors', Specialised Studies I.

Auld, M. (2021b), 'Escaping Stereo', Specialised Studies II, Presentation.

Auld, M. (2021c), 'Towards a binaural immersive studio: Technical factors in current and future binaural popular music production practice', Specialised Studies II, Essay.

Barrett, N. (2002), Spatio-musical composition strategies, *Organised Sound*, Vol 7, Issue 3, pp313-323. doi:10.1017/S1355771802003114

Barrett, N. (2017), 'Trends in Electroacoustic Music', in Collins, N. & d'Esquiván, J. (eds.) (2017), *The Cambridge Companion to Electronic Music*, 2nd Edition, Cambridge University Press, Cambridge.

Barrett, N. (2022), 'Spatial music composition', in *3D Audio* (pp. 175-191). Routledge, Abingdon / New York.

Bennett, S. (2019), *Modern records, maverick methods: Technology and process in popular music record production 1978-2000*, Bloomsbury Academic, New York/London.

Blauert, J. and Braasch, J., (2020), *The Technology Of Binaural Understanding*, Springer, Cham, Switzerland.

Blessner, B & Salter, L., (2007), *Spaces Speak, Are You Listening? Experiencing Aural Architecture*, The MIT Press, Cambridge, Massachusetts, London, England.

Boren, B. (2018), 'History of 3D Sound', in Roginska, A. & Geluso, P. (eds.), *Immersive Sound -The Art and Science of Binaural and Multi-Channel Audio*, [Ebook] Routledge, New York, Available at: <https://www.taylorfrancis.com/books/e/9781315707525>

Borio, G. (2016), *Musical Listening in the Age of Technological Reproduction*, Routledge, Abingdon/New York.

Bourbon, A. and Zagorski-Thomas, S., (2020). *The Bloomsbury handbook of music production*. Bloomsbury Academic, New York.

- Bregman, A. S. (1990), *Auditory Scene Analysis, The Perceptual Organization of Sound* <https://mitpress.mit.edu/books/auditory-scene-analysis>
- Bresler, Z. J. (2019), 'Immersed in Pop: Rethinking Spatiality and Directionality for a Post- Stereo World. / Art of Record Production', conference paper. 17-19 May. Abstract available at: <https://arp19.sched.com/event/L4F4/immersed-in-pop-rethinking-directionality-inpopular-music-for-a-post-stereo-world>
- Bresler, Z. J. (2019), 'The Isotropic Approach to Immersive Music Production - A seminar on surround and immersive music making by Zachary Bresler', University of Agder. Abstract available at: <https://www.uia.no/en/research/kunstfag/electronic-music>
- Bresler, Z. J. (In press), An isotropic approach to music mixing – publication to be announced
- Burt, P. (2001), *The Music of Tōru Takemitsu*, Cambridge University Press, New York.
- Case, A. (2007), *Sound FX - Unlocking the Creative Potential of Recording Studio Effects*, Focal Press, Abingdon, Burlington.
- Chion, M. (2016), *Sound: An Acoulogical Treatise*, Duke University Press, Durham and London doi:10.1215/9780822374824
- CIRMMT, (2014), 'Denis Smalley - Spatiality in acousmatic music' [Online Video] Available at: <https://www.youtube.com/watch?v=G68Q4gkOMc&t=204s> (accessed 10/8/22).
- Close, F. (2009), *Nothing - A Very Short Introduction*, Oxford University press, New York.
- Cockos Incorporated (2022), REAPER <https://www.reaper.fm/> (accessed 10/8/22).
- Collins, N. & d'Esquiván, J. (eds.) (2017), *The Cambridge Companion to Electronic Music*, 2nd Edition, Cambridge University Press, Cambridge.
- Cooke, M. (2017), *Pat Metheny: the ECM years, 1975–1984*, Oxford University press, New York.
- Cornell, J. (2021), 'Q&A with Immersive Trailblazer Ronald Prent' [Online] available at: <https://immersiveaudioalbum.com/2021/11/qa-with-immersive-trailblazer-ronald-prent-grammy-nominated-producer-engineer/> (accessed 10/8/22).
- Creswell Crags (2022), [Online] Available at: <https://www.creswell-crags.org.uk/>, (accessed 10/8/22).
- Csikszentmihalyi, M. (2016). *The systems model of creativity: The collected works of Mihaly Csikszentmihalyi*. Springer.
- Dali's Deathmask (2019), *Drowned In Sound* [Online Audio] Available at: <https://soundcloud.com/dalis-deathmask/drowned-in-sound-vr?in=dalisdeathmask/sets/the-art-of-periphonic-record-production> (accessed 10/8/22).
- Dali's Deathmask, (2019), *Far From Here* [Online Audio] Available at: <https://soundcloud.com/dalis-deathmask/far-from-here-vr?in=dalis-deathmask/sets/the-art-of-periphonic-record-production> (accessed 10/8/22).
- Darkfield Radio, (2022) FAQs and Troubleshooting, [Online] available at: <https://www.darkfield.org/radio-faqs> (accessed 10/8/22).
- Del Sordo, G. (2021), The Headphone Whisperer, [Online] available at: <https://www.sienna.studio/wp-content/uploads/2021/03/Giancarlo-Del-Sordo-The-Headphone-Whisperer.pdf> (accessed 10/8/22).
- DeSalle, R. (2018), *Our Senses - An Immersive Experience*, Yale University Press, New Haven / London.
- Deutsch, D. (2012), *The Psychology of Music*, 3rd Edition, Academic Press.

- Dockwray, R. & Moore, A. (2010), 'Configuring the sound-box 1965–1972', *Popular Music*, Vol. 29, Issue 2, pp.181-197, doi:10.1017/S0261143010000024
- Dolby, (2021), 'How should I approach creating a mix in Atmos that works across headphones and speakers', [Online] available at: https://professionalsupport.dolby.com/s/article/How-should-I-approach-creating-a-mix-in-Atmos-that-works-across-headphones-and-speakers?language=en_US (accessed 10/8/22).
- Doyle, P. (2005), *Echo and Reverb: Fabricating Space in Popular Music Recording, 1900–1960*. Wesleyan University Press, Middletown, Conn.
- Eaton, C. & Lee, H. (2022), 'Subjective Evaluations of Three-Dimensional, Surround and Stereo Loudspeaker Reproductions using Classical Music Recordings', *Acoustical Science and Technology*, vol. 43, no. 2, pp. 149-161. <https://doi.org/10.1250/ast.43.149>
- Emmerson, S. (2007), *Living Electronic Music*, Ashgate, p.161-2.
- Eventide Audio, (2020), 'LIVE: Getting Immersive with George Massenburg' [Online Video] Available at: https://www.youtube.com/watch?v=NFc0vA88_vI&t=2094s & https://www.youtube.com/watch?v=NFc0vA88_vI&t=2673s (accessed 10/8/22).
- Everest, F. and Streicher, R. (1998), *The new stereo Soundbook*, 2nd Edition. Audio Engineering Associates, Pasadena.
- Fabbri in (Systematische Musikwissenschaft) Julia Merrill (eds.) (2017), *Popular Music Studies Today - Proceedings of the International Association for the Study of Popular Music* VS Verlag für Sozialwissenschaft
- Farina, A. (2021), 'EQ Filters Headphones' [Online] available at: <http://pcfarina.eng.unipr.it/Aurora/Headphones-EQ.htm> accessed: 11/02/2022.
- Farnell, A. (2010), *Designing Sound*, The MIT Press, Cambridge, Massachusetts.
- Fehmi, L. & Robbins, J. (2008), *The open-focus brain*. 1st ed. Trumpeter, Boston.
- Flux:: Software Engineering (2022), SPAT Revolution <https://www.flux.audio/project/spat-revolution/> (accessed 10/8/22).
- Francombe, J. Brookes, T. & Mason, R. (2018), 'Determination and Validation of Mix Parameters for Modifying Envelopment in Object-Based Audio', *Journal of the AES*, Volume 66, No 3, pp. 127-145, [Online] Available at: <http://www.aes.org/e-lib/browse.cfm?elib=19381> (accessed 10/8/22).
- Frith, S. & Zagorski-Thomas, S. (2016), *The Art of Record Production - An Introductory Reader for a New Academic Field*, Routledge, Abingdon/New York.
- Gann, K. (1995), *The music of Conlon Nancarrow*, Cambridge University Press, Cambridge.
- Garner, T. A. (2017), *Echoes of Other Worlds: Sound in Virtual Reality: Past, Present and Future*. Palgrave Studies in Sound, Springer. <<http://www.springer.com/gb/book/9783319657073>>
- Garriga, A. Fuenmayor, E. & Caballero, M. (2017), 'Binaural tools for 3D audio production at home', [Online] available at: <https://zenodo.org/record/1299869#.YJwElGjTWUk> (accessed 10/8/22).
- Geluso, P. (2018), 'Stereo', in Roginska, A. & Geluso, P. (eds.), *Immersive Sound - The Art and Science of Binaural and Multi-Channel Audio*, [Ebook] Routledge, New York, Available at: <https://www.taylorfrancis.com/books/e/9781315707525>
- Genelec, (2021), 'Aural ID', [Online] available at: <https://www.genelec.com/aural-id> (accessed 10/8/22).

Gerzon, M. A. (1973), 'Periphony: With-Height Sound Reproduction', *J. Audio Eng. Soc.*, vol. 21, no. 1, pp. 2-10, [Online] Available at: <https://www.aes.org/e-lib/browse.cfm?elib=2012> (accessed 10/8/22).

Gibbs, T. (2007), *The fundamentals of Sonic Art & Sound Design*. AVA Books, Lausanne.

Gottschalk, J. (2016), *Experimental Music Since 1970*. [Kindle PC Edition] Bloomsbury publishing, USA, Available at: <https://www.amazon.co.uk/Experimental-Music-Since-Jennie-Gottschalk-ebook/dp/B01H4T6K76>

Griesinger, D. (2021), Welcome to DGsonicFocus and David Griesinger's home page! [Online] available at: <http://www.dgsonicfocus.com/> (accessed 10/8/22).

Heller, E. J. (2012), *Why you hear what you hear: An experiential approach to sound, music, and psychoacoustics*, Princeton University Press, Princeton/Woodstock.

Hendy, D. (2013), *Noise: A Human History of Sound and Listening* [Kindle PC version] Profile books Ltd, London, Available at: <https://www.amazon.co.uk/Noise-Human-History-Sound-Listening-ebook/dp/B00BHA8A0E> (accessed 10/8/22).

Hepworth-Sawyer, R. & Hodgson, J. (2017), *Mixing music*, Routledge, New York/Abingdon.

Hepworth-Sawyer, R. Hodgson, J. & Marrington, M. (eds.) (2019), *Producing Music (Perspectives on Music Production)*, [Kindle PC Edition] Routledge, Available at: <https://www.amazon.co.uk/Producing-Music-Perspectives-Production-ebook/dp/B07Q4FRYM3>

Hodgson, J. (2019), *Understanding Records, Second Edition: A Field Guide to Recording Practice*, [Kindle PC Edition] Bloomsbury, New York/London, Available at: <https://www.amazon.co.uk/gp/product/B07SPB9GGY>

Huron, D. (2001), Tone and voice: A derivation of the rules of voice-leading from perceptual principles. *Music Perception*, 19(1), 1-64.

Huron, D. (2018), *Voice Leading: The Science behind a Musical Art*, The MIT Press, Cambridge, Massachusetts.

Iida, K. (2019), *Head-Related Transfer Function and Acoustic Virtual Reality*, [eBook] Springer Nature Singapore.

Inglis, S. 'Genelec Aural ID' (2022a), [Online] available at: <https://www.soundonsound.com/reviews/genelec-aural-id> (accessed 10/8/22).

Inglis, S. (2022b), An Introduction to Immersive Audio, Sound on Sound Magazine [Online] available at: <https://www.soundonsound.com/techniques/introduction-immersive-audio>, (accessed 10/8/22).

Inglis, S. (2022c), Lost in space, Sound on Sound Magazine [Online] available at: <https://www.soundonsound.com/magazine/2022-01> (accessed 10/8/22).

Jack Hooley, (2019a), *Cat Fantastic*, [Online Audio] Available at: https://hoast.iem.at/play/cat_fantastic_o3/ (accessed 10/8/22).

Jack Hooley, (2019b), *Cat Fantastic (fixed timbre)*, [Online Audio] Available at: https://hoast.iem.at/play/cat_fantastic_fixed_timbre_o3/ (accessed 10/8/22).

Jaloza, L. B. (2020), 'Inside Facebook Reality Labs Research: The Future of Audio', [Online] available at: <https://about.fb.com/news/2020/09/facebook-reality-labs-research-future-ofaudio/> (accessed 10/8/22).

Judkins, R. (2015), *The Art of Creative Thinking*, [Kindle PC Edition] Sceptre, London, Available at: <https://www.amazon.co.uk/dp/B00O13O1GQ>

Kane, B. (2014), *Sound Unseen Acousmatic Sound in Theory and Practice*, Oxford University press, New York.

Kapuscinski, J. & Rose, F (2020), 'Shō' [Online] available at: <https://gagaku.stanford.edu/en/woodwinds/sho/> (accessed 10/8/22).

Katz, M. (2010), *Capturing sound - how technology has changed music* - University of California Press, Los Angeles/London.

Keep, A. (2005), 'Does Creative Abuse Drive Developments in Record Production?' First Conference of the Art of Record Production, 2005, London, UK. [Online] Available at: <http://www.artofrecordproduction.com/aorpjoom/arpconferences/arp-2005/17-arp-2005/72-keep-2005> (accessed 10/8/22).

Kopf, D. (2019), 'How headphones are changing the sound of music' <https://qz.com/1752321/how-headphones-are-changing-music/> (accessed 10/8/22).

Kraugerud, E. (2017), 'Meanings of Spatial Formation in Recorded Sound', *Journal on the Art of Record Production*, Issue 11, [Online] Available at: <https://www.arpjournal.com/asarpwp/meanings-of-spatial-formation-in-recordedsound/> (accessed 10/8/22).

Lacasse, S. (2000), 'Intertextuality and Hypertextuality in Recorded Popular Music'. In: Moore, A. F. (ed.) (2007) *Critical Essays in Popular Musicology*. Aldershot: Ashgate, pp. 147-170.

Lane, G. (2019), 'Feature: How David Lynch's Twin Peaks Influenced The Legend Of Zelda Series', [Online] available at: https://www.nintendolife.com/news/2019/12/feature_how_david_lynchs_twin_peaks_influenced_the_legend_of_zelda_series (accessed 10/8/22).

Lawrence, R. (2019), 'Producing Music for Immersive Audio Experiences', in Hepworth-Sawyer, R. Hodgson, J. & Marrington, M. (eds.), *Producing Music (Perspectives on Music Production)*, [Kindle PC Edition] Routledge, Available at: <https://www.amazon.co.uk/Producing-Music-Perspectives-Productionebook/dp/B07Q4FRYM3>

Lee, H. (2016), 'Phantom Image Elevation Explained'. In: Audio Engineering Society Convention 141. Available at: www.aes.org/e-lib/browse.cfm?elib=18468

Lee, H. (2017), 'Sound Source and Loudspeaker Base Angle Dependency of Phantom Image Elevation Effect'. *Journal of Audio Engineering Society* 65(9): 733–748. Available at: www.aes.org/e-lib/browse.cfm?elib=19203

Lee, H. (2018), Psychoacoustics of 3D Sound Recording: Research and Practice, available at: https://pure.hud.ac.uk/files/13658202/HLee_Psychoacoustics_of_3D_Sound_Recording.pdf (accessed 10/8/22).

Lee, H. (2020), 'Genelec Aural ID', *Resolution*, January/February 2020, pp 22-23 [Online] Available at: https://www.resolutionmag.com/wpcontent/uploads/2020/02/Genelec_Aural_ID_Resolution_V19.1-Jan-Feb-2020.pdf (accessed 10/8/22).

Linkwitz, S. (2007), 'Room Reflections Misunderstood?', 123rd AES Convention, New York, [Online] Available at: <http://www.linkwitzlab.com/AES123-final2.pdf> (accessed 10/8/22).

Llewellyn, R. (Guest), (2019), 'Immersive Audio Podcast Episode 20 Immerse(d) London 2019' [pod-cast] March 3rd, available at: <https://www.podbean.com/media/share/dir-sp3vi-5b170f9> (accessed 10/8/22).

Lofi Girl, (2022), [Online] available at: <https://www.youtube.com/c/LofiGirl> (accessed 10/8/22).

Lord, J. (2020), 'Re-defining the Spatial Stage – Re-staging the Voice' Jo Lord, [Online Video] Available at: <https://www.youtube.com/watch?v=5vK82GLK81c> (accessed 10/8/22).

Lord, J. (2022), 'Redefining the spatial stage: non-front-orientated approaches to periphonic sound staging for binaural reproduction', in *3D Audio* (pp. 256-273). Routledge, Abingdon / New York.

Mayo, A. (2021), 'Live Masterclass: Producing High Quality Immersive Audio', AES Immersive Audio Academy, [Online Video] Available at: <https://aesshow.com/immersive-ondemand> (accessed 10/8/22).

Meyer-Kahlen, N., Rudrich, D., Brandner, M., Wirler, S., Windtner, S. & Frank, M. (2020), 'DIY Modifications for Acoustically Transparent Headphones' [Online] available at: <https://www.aes.org/e-lib/browse.cfm?elib=20841> (accessed 10/8/22).

Microsoft Research, (2021), 'Project Triton - Immersive sound propagation for games and mixed reality', [Online] available at: <https://www.microsoft.com/enus/research/project/project-triton/> (accessed 10/8/22).

Mincieli in Tape Op Podcast (2022), 'Episode 69: Ann Mincieli', [Online] Available at: <https://soundcloud.com/tapeopmagazine/tape-op-podcast-episode-69-ann-mincieli> (accessed 10/8/22).

Moorefield, V., (2010), *The producer as composer*. Cambridge (Massachusetts): MIT Press.

Moulton, D. (2002), *Total recording*, KIQ Productions, Sherman Oaks.

Mourjopoulos, J. (2020), 'Modeling the Aesthetics of Audio-Scene Reproduction', in Blauert, J. and Braasch, J. (Eds), *The Technology of Binaural Understanding*, Springer, Cham, Switzerland.

Moylan, W. (2012), 'Considering Space in Recorded Music', in Frith, S. & Zagorski-Thomas, S. (Eds.), *The Art of Record Production - An Introductory Reader for a New Academic Field*, Ashgate Publishing Ltd, Surrey.

Moylan, W. (2015), *Understanding and crafting the mix: the art of recording*, [Kindle PC version] Focal Press, Abingdon/Burlington, Available at: <https://www.amazon.co.uk/Understanding-Crafting-Mix-Art-Recording-ebook/dp/B00OM1HYZW/>

MTV, (2022), How Lo-Fi Beats's Nostalgic Comfort Transcended The Memes <https://www.mtv.com/news/e4ndyz/lofi-hip-hop-beats-anxiety-livestream-meme>, (accessed 10/8/22).

Nicol, R. (2020), 'Creating Auditory Illusions with Spatial-Audio Technologies', in Blauert, J. and Braasch, J., (2020), *The Technology Of Binaural Understanding*, Springer, Cham, Switzerland.

Nintendo, (2022), 'Make All Characters Suspicious Types', [Online] available at: <https://www.nintendo.co.uk/Iwata-Asks/Iwata-Asks-The-Legend-of-Zelda-Spirit-Tracks/Iwata-Asks-Zelda-Handheld-History-/3-Make-All-Characters-Suspicious-Types/3-Make-All-Characters-Suspicious-Types-233845.html> (accessed 10/8/22).

Nura, (2021), 'How it works' [Online] available at: <https://www.nuraphone.com/pages/howit-works> (accessed: 10/8/22).

Oltheten, W. (2018), *Mixing with Impact: Learning to Make Musical Choices*, Routledge, New York /London.

Owsinski, B. (2017), *The Mixing Engineer's Handbook 4th Edition*, [Kindle PC version] Bobby Owsinski Media Group, Burbank, Available at: <https://www.amazon.co.uk/Mixing-Engineers-Hand-book-4th-ebook/dp/B01N6SFVMS>

Pamies, S. (2021), Deconstructing Modal Jazz Piano Techniques: The Relation between Debussy's Piano Works and the Innovations of Post-Bop Pianists. *Jazz Education in Research and Practice* 2(1), 76-105. <https://www.muse.jhu.edu/article/811550>

Paterson, J. & Llewellyn, G. (2019), Producing 3-D Audio, in Hepworth-Sawyer, R. Hodgson, J. & Marrington, M. (eds.), *Producing Music (Perspectives on Music Production)*, [Kindle PC Edition] Routledge, Available at: <https://www.amazon.co.uk/Producing-Music-Perspectives-Production-book/dp/B07Q4FRYM3>

Pecknold, R. (Guest), (2021), Tape op, Episode 51, Robin Pecknold of Fleet Foxes, [online podcast] available at: <https://soundcloud.com/tapeopmagazine/tape-op-podcast-episode-51-robinpecknold-of-fleet-foxes> (accessed 10/8/22).

Pfanzagl-Cardone, E. (2021), *The Art and Science of Surround and Stereo Recording*. Springer.

Phillips, W. (2018), 'Video Game Composers: The Art of Music in Virtual Reality' [Online] Available at: <https://winifredphillips.wordpress.com/2018/02/13/video-game-composers-the-art-of-music-in-virtual-reality-gdc-2018/> (accessed 10/8/22).

Pike, C. W. (2019), *Evaluating the Perceived Quality of Binaural Technology*. PhD thesis, University of York. [Online] Available at: <http://etheses.whiterose.ac.uk/24022/> (accessed 10/8/22).

PlayStation, (2020), The Road to PS5 [Online Video] available at: <https://www.youtube.com/watch?v=ph8LyNIT9sg&t=2304s> (accessed 10/8/22).

Princeton, (2020c), 'BACCH™ Filters: Optimized Crosstalk Cancellation for 3D Audio over Two Loudspeakers', Princeton University, [Online] Available at: https://www.princeton.edu/3D3A/BACCH_intro.html (accessed 10/8/22).

Professor Chill, (2018), 'Jo Lord: 3D Audio for Music: Investigating 3D recomposition for binaural reproduction', [Online Video] Available at: <https://www.youtube.com/watch?v=mrAIC2pKo7M> (accessed 10/8/22).

Pulkki, V. and Karjalainen, M., (2015), *Communication Acoustics: An Introduction to Speech, Audio and Psychoacoustics*. 1st ed. Wiley, Chichester.

Recording Studio Rockstars, (2020), 'RSR236 - Andrés Mayo - How To Create 360 Immersive Audio for Music, VR & Games From Your Studio', [Online Video] Available at: <https://www.youtube.com/watch?v=26xoVKz0IPs&t=1h28m58s> & <https://www.youtube.com/watch?v=26xoVKz0IPs&t=1h19m30s> (accessed 10/8/22).

Reich, S. (2002), *Writings on music, 1965-2000*, Oxford University Press, New York.

Ridgway, E. (2019), 'Valve Index - Ear Speakers - Research, Design, and Evolution' [Online] available at: <https://www.valvesoftware.com/en/index/deep-dive/ear-speakers> (accessed 10/8/22).

Riot Games Music, (2021), Sessions: Diana | A Creator-Safe Collection | Riot Games Music, [Online Video] available at: <https://www.youtube.com/watch?v=mtv8WkYyK0s> (accessed 10/8/22).

Roads, C. (2015), *Composing Electronic Music, A New Aesthetic*, Oxford University Press, New York.

Roginska, A. & Geluso, P. (eds.) (2018), *Immersive Sound - The Art and Science of Binaural and Multi-Channel Audio*, [Ebook] Routledge, New York, Available at: <https://www.taylorfrancis.com/books/e/9781315707525>

Roginska, A. (2018), 'Binaural Audio Through Headphones', in Roginska, A. & Geluso, P. (eds.), *Immersive Sound - The Art and Science of Binaural and Multi-Channel Audio*, [Ebook] Routledge, New York, Available at: <https://www.taylorfrancis.com/books/e/9781315707525>

Rudrich, (2021), 'Directivity Shaper Guide'[Online] available at: <https://plugins.iem.at/docs/directivityshaper/> (accessed 10/8/22).

Rumsey, F. and McCormick, T. (2021), *Sound and Recording* 8th ed, Taylor and Francis, Abingdon/New York.

Rumsey, F. and McCormick, T. (2014), *Sound and Recording* 7th ed, Taylor and Francis, Kindle Edition.

S3A Project, (2017), 'Controlling Envelopment for Immersive Spatial Audio', [Online Video] Available at: <https://www.youtube.com/watch?v=Kk9iRUfd11M&t=1m34s> (accessed 10/8/22).

Satongar, D. (2016), 'Simulation and analysis of spatial audio reproduction and listening area effects' [Online] available at: <http://usir.salford.ac.uk/id/eprint/40652/> (accessed 10/8/22).

Schafer, R., (1994), *Our sonic environment and the soundscape*. Destiny Books, Rochester, Verm.

Schmidt Horning, S. (2015), *Chasing Sound: Technology, Culture, and the Art of Studio Recording from Edison to the LP*, John Hopkins Press, Maryland.

Schulein, R. (2014), 'Francis Rumsey-Spatial Audio-Reconstructing Reality or Creating Illusion?' [Online Video] Available at: <https://www.youtube.com/watch?v=y82nth2Pnwk&t=1h7m1s> (accessed 10/8/22).

Selfon, S. (2021), 'Audio Futures: Technologies for Games', AES Immersive Audio Academy 2021, [Online Video] available at: <https://aesshow.com/immersive-ondemand/> (accessed 10/8/22).

Sheron, (2016), *Homecoming*, [Online Audio] Available at: <https://tidal.com/browse/track/89902262> (accessed 10/8/22).

Smalley, D. (2007), Space-form and the acousmatic image, *Organised Sound*, Vol 12, Issue 1, pp35-58. doi:10.1017/S1355771807001665.

Sonic Scoop, (2022), 3D Adventures in Binaural Audio: Sheron's "The Late Great Bloomer" [Online] available at: <https://sonicscoop.com/3d-adventures-in-binaural-audio-sherons-the-late-great-bloomer> (accessed 10/8/22).

Sony, (2020), 'Sony | 360 Reality Audio vs. conventional stereo sound', [Online Video] available at: <https://www.youtube.com/watch?v=wkya01ZKboU> (accessed 10/8/22).

Spencer, E. (2017), Re-orientating Spectromorphology and Space-form through a Hybrid Acoustemology, *Organised Sound*, Vol22, Issue 3, pp324-335. doi:10.1017/S1355771817000486

Sterne, J. (2003), *The Audible Past - Cultural Origins of Sound Reproduction*, Duke University Press.

Stitt, P. (2018), 'aXRotate Update to v1.2.0 Now With Head Tracking!', SSA Plugins, [Online] available at: <https://www.ssa-plugins.com/blog/2018/02/27/axrotate-update-to-v1-2-0/> (accessed 10/8/22).

Streicher, R. & Everest, F. A. (2006), *The New Stereo Soundbook*, 3rd Edition, Audio Engineering Associates, Pasadena.

Studio Ion, (2020), Profile, Takeshi Kokubo, [Online] Available at: <http://studio-ion.com/profile/> (accessed 10/8/22).

Swedien, B. (2013), *The Bruce Swedien Recording Method*, Hal Leonard Books, Milwaukee.

Théberge, P. Devine, K. & Everett, T. (2015), *Living Stereo - Histories and Cultures of Multichannel Sound*, Bloomsbury Academic, New York/London.

Thomas, R.M. (2022), 'Credits' [Online] Available at: <http://robertthomassound.com/projects/>, (accessed 10/8/22).

Toole, F. E. (2017), *Sound Reproduction: The Acoustics and Psychoacoustics of Loudspeakers and Rooms*, 3rd Ed. New York/London, Routledge.

- Tufnell, N. (2014), 3D sound experiments carried out by BBC R&D engineers, <https://www.bbc.co.uk/news/technology-26958946> (accessed 10/8/22).
- University of Derby, (2018), 'Sounds in Space 2018 Day 1', [Online Video] Available at: <https://www.youtube.com/watch?v=n4cXByfERko&t=3h23m45s> (accessed 10/8/22).
- University of Derby, (2019) Sounds in Space 2019 day 2 [Online lecture] available at: <https://www.youtube.com/watch?v=X2KiNd3tGTg> (accessed 10/8/22).
- Vice, (2022), How 'Lofi Hip Hop Radio to Relax/Study to' Became a YouTube Phenomenon <https://www.vice.com/en/article/594b3z/how-lofi-hip-hop-radio-to-relaxstudy-to-became-a-youtube-phenomenon>, (accessed 10/8/22).
- Walton, T., (2017), September. The overall listening experience of binaural audio. In *Proceedings of the 4th International Conference on Spatial Audio (ICSA), Graz, Austria*.
- Waniata, (2019), 'Sony's 360 Reality Audio is the epic sound revolution you didn't know you needed', Digital Trends, [Online] available at: <https://www.digitaltrends.com/hometheater/ears-on-with-sonys-brain-bending-360-reality-audio-ces-2019/> (accessed 10/8/22).
- Watkinson, J. (2012), *Art of Sound Reproduction*, Focal Press, Burlington/Abingdon.
- Waves Audio Ltd. (2021), 'Nx – Virtual Mix Room over Headphones', [Online] available at: <https://www.waves.com/plugins/nx> (accessed 10/8/22).
- Wenzel, E. M., Begault, D. R. & Godfroy-Cooper, M. (2018), 'Perception of Spatial Sound', in Roginska, A. & Geluso, P. (eds.), *Immersive Sound - The Art and Science of Binaural and Multi-Channel Audio*, [Ebook] Routledge, New York, Available at: <https://www.taylorfrancis.com/books/e/9781315707525>
- Werner, D. (2020) 'GASP - Guitars with Ambisonic Spatial Performance', [Online] Available at: <http://gaspproject.xyz/> (accessed 10/8/22).
- Werner, D., Wiggins, B. & Fitzmaurice, E. (2020), 'Development of an Ambisonic Guitar System - GASP: Guitars with Ambisonic Spatial Performance' [Online] Available at: <http://gaspproject.xyz/innovation-in-music/> (accessed 10/8/22).
- Wiggins, B. & Dring, M. (2018), 'How High is Enough? Strategies for Ambisonics Immersive Audio over Headphones' [Online] available at: <https://www.brucewiggins.co.uk/wpcontent/uploads/2018/09/Dring-Wiggins-SinS-2018.pdf> (accessed 10/8/22).
- Wiggins, B. & Werner, D. (Guests), (2020), 'Immersive Audio Podcast Episode 40 – Bruce Wiggins & Duncan Werner (University of Derby & GASP)' [podcast] Available at: <https://www.1618digital.com/immersive-audio-podcast-episode-40-bruce-wiggins-duncanwerner-university-of-derby-gasp/> (accessed 10/8/22).
- Wiggins, B. (2017), 'Ambisonics to Binaural HRTF Animations' [Online] available at: <https://www.brucewiggins.co.uk/?p=1095> (accessed 10/8/22).
- Zagorski-Thomas, S. (2014), *The Musicology of Record Production*, Cambridge University Press, Cambridge.
- Zagorski-Thomas, S. (2016), 'Sonic Cartoons'. In: Papenburd, J. G., & Schulze, H. (eds.), *Sound as Popular Culture: A Research Companion*. (n.p.): The MIT Press, pp. 403-410.
- Ziegelwanger, H., Majdak, P. & Kreuzer, W. (2015), 'Numerical Calculation of Listener-specific Head-related Transfer Functions and Sound Localization: Microphone Model and Mesh Discretization', *The Journal of the Acoustical Society of America*, v138(1). <http://dx.doi.org/10.1121/1.4922518>

Zieliński, S.K. & Lee, H., 2019, Automatic Spatial Audio Scene Classification in Binaural Recordings of Music. *Applied Sciences*, 9(9), p.1724. Available at: <http://dx.doi.org/10.3390/app9091724>

Ziemer, T., (2020). *Psychoacoustic Music Sound Field Synthesis: Creating Spaciousness for Composition, Performance, Acoustics and Perception*. Springer, Cham.

Zotter & Frank (2019), *Ambisonics* - 10.1007/978-3-030-17207-7

Discography

Barboza, José Ricardo (producer), Alana Moraes - *Seresta das quatro estações* (2018) available at: <https://www.youtube.com/watch?v=n4cXByfERko&t=6237s> (accessed 10/8/22).

Barrett, Natasha, (2007–2019), Soundcloud discography [Online audio] available at: <https://soundcloud.com/search?q=natasha%20barrett%20binaural> (accessed 10/8/22).

Can - *Flow Motion*, (1976) available at: <https://open.spotify.com/album/1huoZCDAoleMugaugmWNxl> (accessed 10/8/22).

Cooper, Max, (2020), Binaural electronica on the *3D Reworks* series [Online audio] available at: <https://maxcooper.bandcamp.com/album/3d-reworks-001> (accessed 10/8/22).

Dali's Deathmask (2019), *Drowned In Sound* [Online Audio] Available at: <https://soundcloud.com/dalis-deathmask/drowned-in-sound-vr?in=dalisdeathmask/sets/the-art-of-periphonic-record-production> (accessed 10/8/22).

Dali's Deathmask, (2019), *Far From Here* [Online Audio] Available at: <https://soundcloud.com/dalis-deathmask/far-from-here-vr?in=dalis-deathmask/sets/theart-of-periphonic-record-production> (accessed 10/8/22).

Dallas Simpson (2005), *Sonic Bathing 1, Waterpump (Aquapump)* [Online audio] available at: <https://open.spotify.com/embed/track/3N9t7wueWiGxFz92E8GKh8> (accessed 10/8/22).

Dempster, Stuart (1995), *Underground Overlays From The Cistern Chapel* [Online audio] available at: <https://tidal.com/browse/album/9108619>

Eno, Brian, (1977), 'Through hollow lands', *Before and after science*, [CD] Polydor.

Fantastic Negrito, (2018), *Please Don't Be Dead* [Online audio] Available at: <https://open.spotify.com/album/4EdNTjVzjlxYqEUGPiyiZS> (accessed 10/8/22).

Fleet Foxes. *Fleet Foxes* (Bella Union) / (Sub Pop SP777), 2008

Jack Hooley, (2019a), *Cat Fantastic*, [Online Audio] Available at: https://hoast.iem.at/play/cat_fantastic_o3/ (accessed 10/8/22).

Jack Hooley, (2019b), *Cat Fantastic (fixed timbre)*, [Online Audio] Available at: https://hoast.iem.at/play/cat_fantastic_fixed_timbre_o3/ (accessed 10/8/22).

Kataoka, M. 片岡真央 かたおか まなか (2017), *Hyrule Field Theme (Day)*

Kataoka, M. 片岡真央 かたおか まなか (2017), *Hyrule Field Theme (Night)*

Kukovecz, A. Pacific Northwest Roadtrip, [Online Audio Playlist] Available at: <https://open.spotify.com/playlist/1SEJfwlC169mTfhtNt10BB?si=0f39e2a237584b17> (accessed 10/8/22).

Lynch, D. & Frost, M. (1990-91), *Twin Peaks* [Television series]

Miyu Hosoi, (2019), *Lenna (2019) Miyu Hosoi*, [Online audio] available at: https://www.youtube.com/watch?v=t_XzR7_h4qY (accessed 10/8/22).

Nahuel Bronzini (2020) @360musiclab, Vol. 1: *Uneven 360* [Online video] available at: https://www.youtube.com/watch?v=gnArQPKC_-M (accessed 10/8/22).

Nintendo (2017), *The Legend of Zelda: Breath of the Wild* [Video game]

Nokuma Satoyama (里山ノクマ) (2018), Fire works show in Sakata Japan [Online video] available at: <https://www.youtube.com/watch?v=poaMoUpLGjM> (accessed 10/8/22).

Pat Metheny Group. *Still Life (Talking)* (Geffen 24145), 1987

Reich, Steve. (1989), *Different Trains and Electric Counterpoint* (Nonesuch 7559- 79176- 2).

Sheron, (2016), *Homecoming*, [Online Audio] Available at: <https://tidal.com/browse/track/89902262> (accessed 10/8/22).

Smalley, Dennis, (2011), *Spectral Lands* [CD] Ymx media.

Takemitsu, T. (1973), *In an Autumn Garden*, for gagaku orchestra (fourth part of complete version In an Autumn Garden).

Takemitsu, T. (1992), *Ceremonial – An Autumn Ode*, for orchestra with shō.

Takeshi Kokubo, (n.d.), Studio Ion – binaural nature recordings, Bandcamp discography, [Online audio] available at: <https://takashikokubo.bandcamp.com/> (accessed 10/8/22).

Tenney, James, (1994), *In a Large, Open Space*.

The Legend of Zelda: Breath of the Wild Original Soundtrack, [Online] Available at: <https://vgmdb.net/album/75831>

Thomas, R. (2021), 'Forest For Change Global Goals Pavilion' *Pavilion Music* <https://www.youtube.com/watch?v=7eYC7-8D4Ok&t=140s> (accessed 10/8/22).

Tokinomakina, (2019), *Mechanophilia Xfade Digest* [Online audio] available at: <https://soundcloud.com/tokenomakina/mechanophilia-xfade-digest> (accessed 10/8/22).

Young, Gayle, (2013), *Gayle Young plays Yoko Ono's secret piece*, [CD] EMF Media Electronic Music Foundation, New York.

Appendices

Appendix 1: Previous findings:

Like 3-D visual reproduction, binaural sound has a long history, but beyond VR, has only attracted sporadic, cyclical interest (Streicher & Everest, 1998:6.11, Robjohns in Tufnell, 2014). This is likely related to the finding that binaural recordings have tended towards spectacular, inartistic demonstrations⁴², and that the most successful work appears to be that embedded in the creative process. Also relevant are technical issues which have continued to affect the medium. Though these seem likely to diminish (through the recent commercial engagement of Dolby, Apple Music⁴³, Universal, Sony, the collective gaming industry and moves towards social VR), they apply to this portfolio.

In previous experiments, I found that low-latency head-tracking in no way enhanced my perception, possibly due to HRTF-mismatch. Similarly, ambisonic⁴⁴ coding, even up to 7th order, seemed to reduce localisation and significantly limited the sense of immersion when compared with native binaural rendering⁴⁵.

There is clearly scope to feature, and potentially a need for, more material in binaural presentation than is appropriate in stereo (Paterson & Llewellyn, 2019:238-40).

Immersion⁴⁶ is a spatial attribute apparently highly valued by listeners (Francombe et al., 2018:127; Eaton & Lee, 2021:159). Additionally, it strongly resonates with ideas central to Fehmi and Robbins' work on attention and the 'objectless imagery' they describe (2008:36-39).

⁴² Sony (2020), for instance.

⁴³ With a streamlined version of Dolby Atmos production tools now included in Apple's Logic music production software.

⁴⁴ Uncapitalised, as per Gerzon's original paper (1973).

⁴⁵ Perhaps through intermediate loudspeaker virtualisation and more fundamental limitations (Paterson & Llewellyn, 2019, p229; Toole, 2017 p426).

⁴⁶ Or envelopment, see Agrawal et al. for thorough definitions (2020).

Appendix 2: Characteristics of the spatial medium – multi-loudspeaker and binaural headphone reproduction compared:

- Timbre is potentially good on speakers and poor on headphones.
- For speakers, localisation is strongest wherever there is a speaker (for instance directly ahead), whereas for headphones, it is strongest at the sides whereas the frontal centre image is often weak and elevated.
- Close proximity is easily achieved on headphones but rarely via speakers; the opposite can be said of distance.
- Transient detail is conveyed much more easily via headphones than speakers.
- Consistency of individual listener experience is relatively good on speakers and poor on headphones.

(Roginska & Geluso, 2018; Rumsey & McCormick, 2014:40, 565; 2021:69, 567-8)

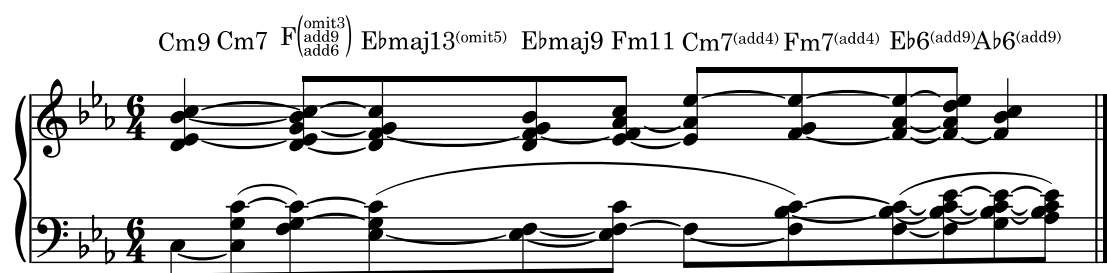
Appendix 3: Technique overview (expanded)

Parameter numbers (0-3) in top four rows indicate degree of intensity.

	- Gorge -			----- Woods -----						- Lake -		----- Reflection -----		
	- intro -		-transition-	Canon 1	Canon 2	Canon 3(i)	(ii)	(iii)	-transition-	-transition-		Canon 1	Canon 2	Canon 3
listener motion vel	1 0	0(1-2)	3	3	3	3-0	3	3-0	3	0	0	0	0	0
source motion vel	0 ~0	0	0	0	0	0	0	0	0	0 1 1	0	1 0 ~1	~1	. ~1
acoustic 'size'	0 1	1 - 3	2	1	2	2-	2+	2+	2	1 2 2+	2-3	0 1 1	1 1 2	1 1 - 3
immersion	0 3	1 - 3	1	1	2	2-3	2-3	2-3	1	1 2 3	3	0 2 1	1 2 2	1 1 3 2
sources/layers:														
recorded bin(r)	(r)		(r)						(r)					
synthesized (s)		(s)		(s)	(s)	(s)	(s)	(s)		(s)	(r)	(s)	(s)	^s (s)
Synthetic:														
direct stereo overlays	0 1--									--0 1				
spatialised stereo images	--2--											1-3	1-3	2 1 - 4
spatialised mono sources		14 + 15 pitches		16 pitches	15 pitches	16 pitches	7 parts	7 parts		61 pitches				
additional render layer					6 parts	6 parts	7 parts	7 parts						
Periphony:														
elevated	/ \	2-----2---	/ \	1	1	1			/.\	17 pitches	/.\	1(st)		2(st)
horizontal	(--rec--)	4+12 pitches	(rec)						(rec)	32 pitches	(rec)			
at depth/below	\ _ /	2-----2	\ /						\./	12 pitches	\./			
encompassment/angle	-	60-360--	-	60-360-60	60-360-60	60-360	30-360-30		-	30-----360	-	0-23-68-180	90-180	23-113-225 45-135-225-315

Appendix 4: Canons in *Woods*:

Canon 1 – part



Canon 1 – fully polyphonic bar



Canon 2 – part



Canon 2 – fully polyphonic bar

Appendix 4: Canons in *Woods*: (cont.)

Canon 3 – part



Canon 3 – fully polyphonic bar

Appendix 5: Canons in *Reflection*:

Canon 1a



Canon 1b



Canon 2a

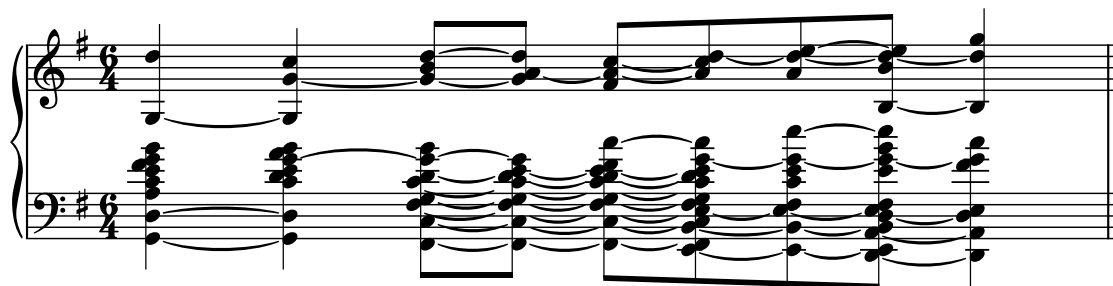


Canon 2b

Appendix 5: Canons in *Reflection*: (cont.)

Four staves of music in G major (one sharp) and 6/4 time. The first staff is a treble clef, the second and third are also treble clefs, and the fourth is a bass clef. The music consists of a single melodic line with various note values and rests, ending with a double bar line.

Canon 3b – part



A single system of music in G major (one sharp) and 6/4 time, featuring a fully polyphonic bar. The system consists of a grand staff with a treble clef and a bass clef. The music is characterized by dense, overlapping chords and complex rhythmic patterns, creating a rich, textured sound.

Canon 3b – fully polyphonic bar

Appendix 6: Technical limitations:

In some circumstances, distortion/clipping may be perceived at specific timestamps (for instance 2:00, 4:33, 4:57, 5:48-51, 26:40-27:40, 28:08). While these artefacts do appear in the recording, they are accentuated during streaming. It seems that they are a form of modulation noise ('zipper' noise) that occurs in some contexts within SPAT when the room size parameter is varied under REAPER control, an issue to be resolved in software. They are far less noticeable - perhaps largely inaudible, depending on the listening conditions - when the piece is played from the downloaded file, though some steps have nevertheless been taken to reduce these artefacts in the uploaded version.

In addition, a software issue causes the spatial transition from monoaural to binaural at the start of *Reflection* [13:44] flickers between the two states.

Appendix 7: Notes on optimal playback:

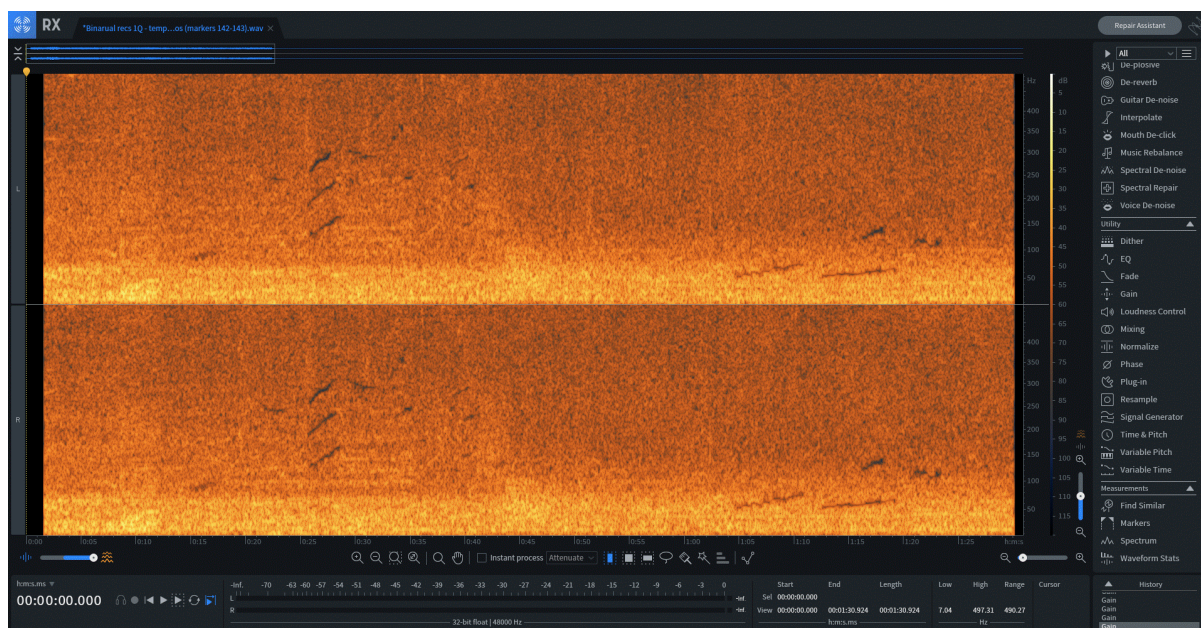
Ideal listening conditions are with high-quality open-backed headphones (such as the Sennheiser HD-650) in a quiet environment.

On some systems, it may be beneficial to set the converter clock rate natively to 48kHz (or perhaps 96kHz) rather than 44.1kHz, thereby avoiding additional sample rate conversion.

Appendix 8: Test works uploaded for reference:

Name	Description
<i>Test-9v</i>	Movement past head-height sources - plus <i>détournement</i>
<i>Test-11-1h</i>	Movement under elevated sources
<i>Test-12-1u</i>	Perception of listener movement past directional sources including delay effect

Appendix 9: Example of motor vehicle harmonic noise removal from field recording:



The Distant Landscape

Score

Movements:

Gorge

Woods

- Canon 1

- Canon 2

- Canon 3(i), 3(ii), 3(iii)

Lake

Reflection

- Part 1

- Part 2, modulation

- Part 3

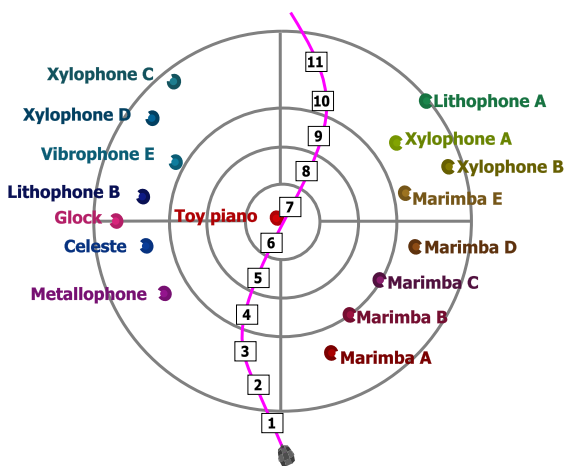
Score preface:

Although each piece is rendered solely using virtual instruments interspersed with field recordings, a full score is included as an aid to the listener in following various spatial transitions and, where appropriate, to support the discussion of pitch.

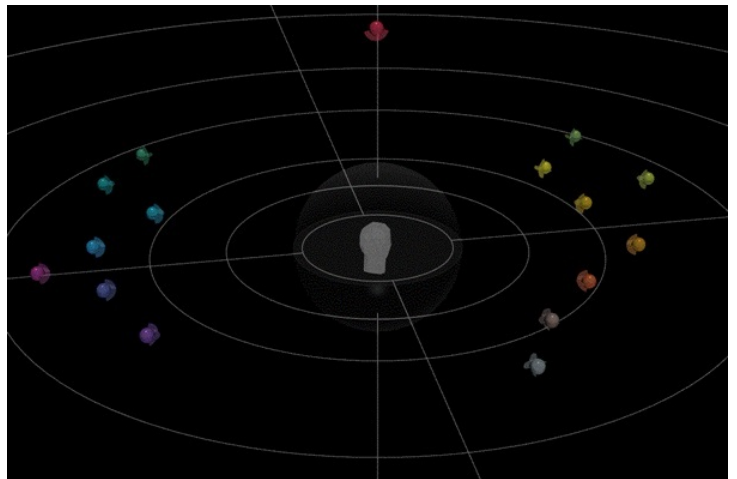
The Distant Landscape

Each piece is accompanied by a diagram showing a plan view of the sound sources in relation to the listener and an oblique view displaying the sources within the 3-D space. A pink line shows the route of listener motion, the head indicating orientation. Bar numbers appear in boxes.

Example plan view:



Example oblique view:



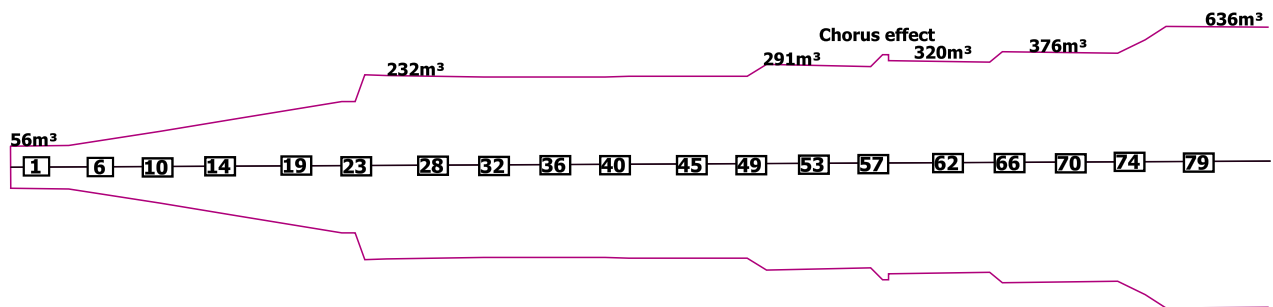
1.Gorge

The piece opens with Field recording 1:

Field recording 1: City [00:00-02:28]

- Transition from centre of small domestic room to 2nd floor window overlooking pedestrian city-centre street
- Indistinct voices, vehicles
- Nottingham Council House quarter chimes [00:44]
- Nottingham Council House Great bell, 8 strikes [01:13]
- Fade out from Gorge entry at 02:08

The source/listener position in Gorge remains constant, though the room size changes throughout the piece as shown in the following diagram:

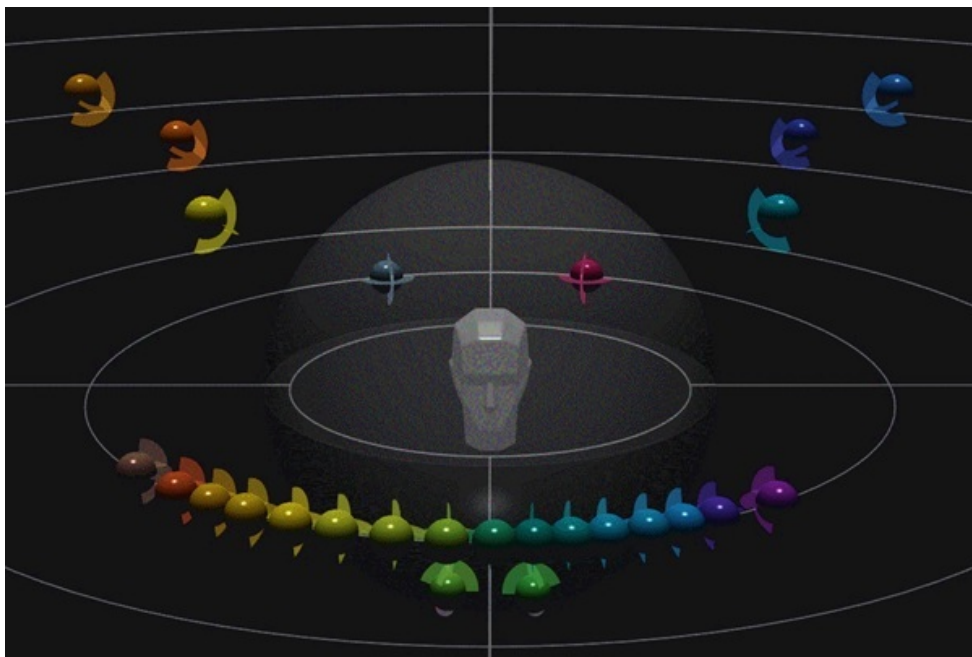
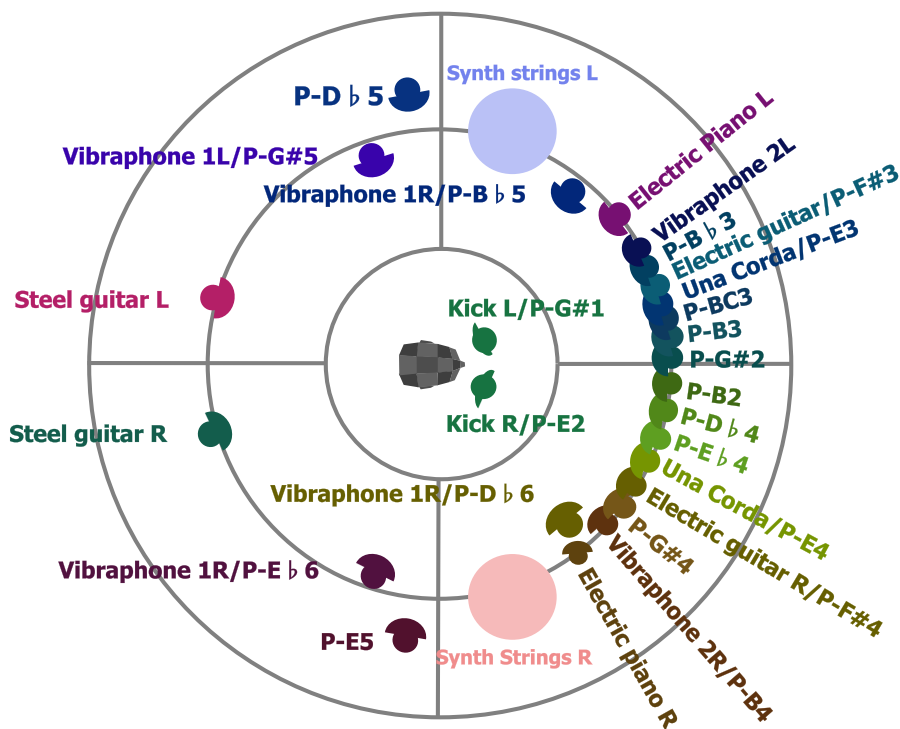


Initial piano melody [bars1-5] is from the spatialised stereo sources labelled *Una Corda*. From bar 23, each piano pitch is played via a separate source, labelled 'P - [pitch]' although some instruments share sources with these pitches.

The dual guitars, vibraphones and electric pianos are played from left and right sources, which are displayed in the score as separate voices.

Synth strings are not spatialised but overlaid as a stereo pair.

Sources are placed at head height apart from the kick drum pair which is below the listener, and vibraphone 1 L/R as well as two piano pitches which are elevated.



1. Gorge

♩ = 80 02:08

Kick Dr. Click R

Kick Dr. Click L

Kick Dr. Beat R

Kick Dr. Beat L

Vibraphone 1

Piano

5

Clk R

Clk L

Kick R

Kick L

Vib 1

Pno

With echo

14

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

17

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

The musical score for 'Gorge' on page 8 consists of six staves. The first four staves (Clk R, Clk L, Kick R, Kick L) are grouped by a vertical line on the left. The key signature is three sharps (F#, C#, G#). The time signature is not explicitly shown but appears to be 4/4. The score is divided into two measures. Measure 1 contains various rhythmic patterns for the drums and a melodic line for Vib 1. Measure 2 continues the patterns. Vib 2 and Pno have sustained notes across both measures. El pno has a melodic line in measure 1 and a sustained note in measure 2.

19

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

This musical score page contains measures 19 and 20 of a piece titled 'Gorge'. The score is arranged for a drum kit and two pianos. The drum kit parts (Clk R, Clk L, Kick R, Kick L) are written on a single grand staff with a common time signature. The two piano parts (Vib 1, Vib 2, Pno, El pno) are written on separate staves. The key signature is one sharp (F#). The score includes various musical notations such as eighth notes, quarter notes, and rests. The Vib 2 and El pno parts feature triplets and sustained chords. The Pno part is mostly silent, with rests in both staves.

21

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

This musical score is for a track titled "Gorge" and is page 10 of a 10-page document. It features a multi-track arrangement with the following instruments and parts:

- Clk R (Clock Right):** A single-stem electronic drum track. It begins at measure 21 with a series of eighth and sixteenth notes, followed by a rest in the second measure.
- Clk L (Clock Left):** A single-stem electronic drum track. It has a rest in the first measure, followed by a series of eighth and sixteenth notes in the second measure.
- Kick R (Kick Right):** A single-stem electronic drum track. It features a pattern of eighth notes and rests across both measures.
- Kick L (Kick Left):** A single-stem electronic drum track. It features a pattern of eighth notes and rests across both measures.
- Vib 1 (Vibraphone 1):** A single-stem vibraphone track. It starts with a rest in the first measure, followed by a half note in the second measure.
- Vib 2 (Vibraphone 2):** A grand staff (treble and bass clef) vibraphone track. It features complex melodic lines with triplets and ties across both measures.
- Pno (Piano):** A grand staff (treble and bass clef) piano track. It contains rests in both measures.
- El pno (Electric Piano):** A grand staff (treble and bass clef) electric piano track. It features complex melodic lines with triplets and ties across both measures.

The score is written in 4/4 time and includes a key signature of three sharps (F#, C#, G#). The measures are separated by a double bar line.

23 03:14

The musical score is arranged in a vertical stack of staves. The first four staves are for drums: Clk R, Clk L, Kick R, and Kick L. They are grouped by a bracket on the left. Clk R and Clk L have a double bar line at the start of the first measure. The next three staves are for Vib 1, Vib 2, and Pno. Vib 1 is a single staff, while Vib 2 and Pno are grand staves (treble and bass clef). The next two staves are for El pno and Synth, also grand staves. The key signature is three sharps (F#, C#, G#). The time signature is not explicitly shown but appears to be 4/4 based on the notation. The score is divided into three measures by vertical bar lines. The first measure shows the initial drum patterns and the start of the vibraphone and piano parts. The second measure continues the patterns, with the piano part featuring a sustained chord. The third measure concludes the patterns, with the piano and synth parts holding sustained chords.

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

Synth

26

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

Pno

El pno

Synth

The musical score for track 'Gorge' begins at measure 26. The score is written for nine instruments: Clk R, Clk L, Kick R, Kick L, Vib 1, Vib 2, Pno, El pno, and Synth. The key signature is five sharps (F#, C#, G#, D#, A#). The Clk R and Clk L staves have a double bar line at measure 26. The Kick R and Kick L staves have a double bar line at measure 26. The Vib 1 staff has a double bar line at measure 26. The Vib 2 staff has a double bar line at measure 26. The Pno staff has a double bar line at measure 26. The El pno staff has a double bar line at measure 26. The Synth staff has a double bar line at measure 26.

27

This musical score page contains measures 27, 28, and 29 of a piece titled 'Gorge'. The score is arranged in a multi-stem system with the following parts from top to bottom: Clk R, Clk L, Kick R, Kick L, Vib 1, Vib 2 (a grand staff), St guit, Pno (a grand staff), El pno (a grand staff), and Synth (a grand staff). The key signature is D major (F# and C#). Measures 27 and 28 are 4/4 time, while measure 29 is 3/4 time. The percussion parts (Clk, Kick) feature complex rhythmic patterns with eighth and sixteenth notes. Vib 1 has a single melodic phrase in measure 28. St guit has a sustained chord in measure 27 and a melodic line in measures 28 and 29. Pno and Synth provide harmonic support with sustained chords and moving lines. El pno remains silent throughout the measures.

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

Pno

El pno

Synth

30

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

Pno

El pno

Synth

The musical score is written for a 3/4 time signature and a key signature of three sharps (F#, C#, G#). The first three measures are shown, with measure 30 indicated at the start. The instruments and their parts are as follows:

- Clk R:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Clk L:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Kick R:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Kick L:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Vib 1:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Vib 2:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- St guit:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Pno:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- El pno:** A single note (F#) in the first measure, followed by a rest in the second and third measures.
- Synth:** A single note (F#) in the first measure, followed by a rest in the second and third measures.

33 04:01

The musical score is for a track titled "Gorge" and is page 15 of a larger work. It features a 3/4 time signature and a key signature of three sharps (F#, C#, G#). The score is divided into three measures, with a rehearsal mark "33" at the beginning and a timecode "04:01" in the first measure. The instruments and their parts are as follows:

- Drums:** Four staves (Clk R, Clk L, Kick R, Kick L) are grouped together. They play a consistent rhythmic pattern of quarter and eighth notes.
- Vib 1:** A single staff with a treble clef. It plays a melodic line consisting of a quarter note, a half note, and a quarter note, with a grace note on the first measure.
- Vib 2:** Two staves with treble clefs. They play a sustained, low-volume chord throughout the measures.
- St guit:** A single staff with a treble clef. It plays a sustained, low-volume chord throughout the measures.
- Pno:** Two staves (treble and bass clefs). The right hand plays a melodic line with a grace note, while the left hand plays a sustained, low-volume chord.
- El pno:** Two staves (treble and bass clefs). The right hand plays a sustained, low-volume chord, while the left hand plays a sustained, low-volume chord.
- Synth:** Two staves (treble and bass clefs). The right hand plays a sustained, low-volume chord, while the left hand plays a sustained, low-volume chord.

36

This musical score page contains measures 36, 37, and 38 of the piece 'Gorge'. The score is written for a multi-instrument ensemble. Measures 36 and 37 are marked with a repeat sign. The instruments and their parts are as follows:

- Clk R (Clock Right):** A single-stemmed staff with a repeat sign at the beginning. The notation consists of quarter notes and rests.
- Clk L (Clock Left):** A single-stemmed staff with a repeat sign at the beginning. The notation consists of quarter notes, eighth notes, and rests.
- Kick R (Kick Drum Right):** A single-stemmed staff with a repeat sign at the beginning. The notation consists of quarter notes and eighth notes.
- Kick L (Kick Drum Left):** A single-stemmed staff with a repeat sign at the beginning. The notation consists of quarter notes and eighth notes.
- Vib 1 (Vibraphone 1):** A single-stemmed staff with a treble clef and a key signature of four sharps (F#, C#, G#, D#). The notation consists of quarter notes and eighth notes.
- Vib 2 (Vibraphone 2):** A grand staff (treble and bass clefs) with a key signature of four sharps. The notation consists of quarter notes and eighth notes.
- St guit (Steel Guitar):** A single-stemmed staff with a treble clef and a key signature of four sharps. The notation consists of quarter notes and eighth notes.
- Pno (Piano):** A grand staff (treble and bass clefs) with a key signature of four sharps. The notation consists of quarter notes and eighth notes.
- El pno (Electric Piano):** A grand staff (treble and bass clefs) with a key signature of four sharps. The notation consists of quarter notes and eighth notes.
- Synth (Synthesizer):** A grand staff (treble and bass clefs) with a key signature of four sharps. The notation consists of quarter notes and eighth notes.

The score is written in a key signature of four sharps (F#, C#, G#, D#) and a 4/4 time signature. The notation includes various musical symbols such as notes, rests, and repeat signs.

39

This musical score page contains measures 39, 40, and 41 of a piece titled 'Gorge'. The score is written for a multi-instrument ensemble. Measures 39 and 40 are marked with a brace and the number '39'. The instruments and their parts are as follows:

- Clk R / Clk L:** Represented by a single staff with two lines. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- Kick R / Kick L:** Represented by a single staff with two lines. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- Vib 1:** A single staff in treble clef with a key signature of four sharps (F#, C#, G#, D#). It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- Vib 2:** A grand staff (treble and bass clefs) in treble clef with a key signature of four sharps. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- St guit:** A single staff in treble clef with a key signature of four sharps. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- Pno:** A grand staff (treble and bass clefs) in treble clef with a key signature of four sharps. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- El pno:** A grand staff (treble and bass clefs) in treble clef with a key signature of four sharps. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.
- Synth:** A grand staff (treble and bass clefs) in treble clef with a key signature of four sharps. It features a double bar line at the start of measure 39, followed by rests in measures 39 and 40, and a quarter note in measure 41.

42

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

Pno

El pno

Synth

44

This musical score page contains measures 44, 45, and 46 of a piece titled 'Gorge'. The score is arranged for a multi-instrument ensemble. Measures 44 and 45 are marked with a common time signature of 4/4. Measure 46 is marked with a 3/4 time signature. The instruments and their parts are as follows:

- Clk R (Clock Right):** Features a rhythmic pattern of eighth and quarter notes in measures 44 and 45, followed by a quarter rest in measure 46.
- Clk L (Clock Left):** Features a rhythmic pattern of eighth and quarter notes in measures 44 and 45, followed by a quarter rest in measure 46.
- Kick R (Kick Drum Right):** Features a rhythmic pattern of eighth and quarter notes in measures 44 and 45, followed by a quarter rest in measure 46.
- Kick L (Kick Drum Left):** Features a rhythmic pattern of eighth and quarter notes in measures 44 and 45, followed by a quarter rest in measure 46.
- Vib 1 (Vibraphone 1):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- Vib 2 (Vibraphone 2):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- St guit (Steel Guitar):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- El guit (Electric Guitar):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- Pno (Piano):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- El pno (Electric Piano):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.
- Synth (Synthesizer):** Features a single note in measure 44, followed by a quarter rest in measure 45, and a quarter rest in measure 46.

The score is written for measures 44, 45, and 46. The key signature is one sharp (F#). The time signature is 4/4 for measures 44 and 45, and 3/4 for measure 46. The instruments are Clk R, Clk L, Kick R, Kick L, Vib 1, Vib 2, St guit, El guit, Pno, El pno, and Synth.

47

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

Detailed description: This musical score page, labeled 'Gorge', begins at measure 47. It features eleven tracks. The drum tracks (Clk R, Clk L, Kick R, Kick L) use a double bar line symbol. Vib 1 is a single melodic line. Vib 2, St guit, and El guit are grand staff pairs with complex, overlapping sustained notes. Pno is a grand staff pair with a more active melodic and harmonic line. El pno and Synth are grand staff pairs, mostly providing sustained harmonic support. The key signature is five sharps (F#, C#, G#, D#, A#).

50

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

Detailed description: This musical score page covers measures 50, 51, and 52. The instrumentation includes electronic drums (Clk R, Clk L, Kick R, Kick L), two vibraphones (Vib 1, Vib 2), two guitars (St guit, El guit), piano (Pno), electric piano (El pno), and synth. The key signature is D major (F# C# G# D). Measure 50 features a complex drum pattern with eighth and sixteenth notes. Vib 1 has a single note in measure 51. Vib 2 and St guit play sustained chords. El guit has a single note in measure 52. Pno and El pno play sustained chords. Synth has a single note in measure 52.

53

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

56 05:56

The musical score is for a track titled "Gorge" at the 05:56 mark, starting at measure 56. The score is written for a multi-instrumental ensemble. The instruments and their parts are as follows:

- Clk R (Clock Right):** A single-stemmed staff with a double bar line at the beginning, indicating it is a drum track. It contains a few notes in the third measure.
- Clk L (Clock Left):** A single-stemmed staff with a double bar line at the beginning, indicating it is a drum track. It contains a few notes in the first and second measures.
- Kick R (Kick Right):** A single-stemmed staff with a double bar line at the beginning, indicating it is a drum track. It contains a few notes in the first and second measures.
- Kick L (Kick Left):** A single-stemmed staff with a double bar line at the beginning, indicating it is a drum track. It contains a few notes in the first and second measures.
- Vib 1 (Vibraphone 1):** A single-stemmed staff with a treble clef and a key signature of D major. It contains a few notes in the third measure.
- Vib 2 (Vibraphone 2):** A grand staff (treble and bass clefs) with a key signature of D major. It contains a few notes in the first measure.
- St guit (Steel Guitar):** A single-stemmed staff with a treble clef and a key signature of D major. It contains a few notes in the third measure.
- El guit (Electric Guitar):** A single-stemmed staff with a treble clef and a key signature of D major. It contains a few notes in the third measure.
- Pno (Piano):** A grand staff (treble and bass clefs) with a key signature of D major. It contains a few notes in the first and second measures.
- El pno (Electric Piano):** A grand staff (treble and bass clefs) with a key signature of D major. It contains a few notes in the first and second measures.
- Synth (Synthesizer):** A grand staff (treble and bass clefs) with a key signature of D major. It contains a few notes in the first and second measures.

59

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

Detailed description: This is a musical score for a track titled 'Gorge', starting at measure 59. The score is written for a multi-instrument ensemble. The key signature consists of five sharps (F#, C#, G#, D#, A#). The instruments and their parts are as follows: Clk R and Clk L (Clocks) play a rhythmic pattern of eighth and sixteenth notes. Kick R and Kick L (Kicks) provide a steady beat. Vib 1 (Vibraphone 1) has a melodic line with grace notes. Vib 2 (Vibraphone 2) is mostly silent. St guit (Steel guitar) plays a melodic line with grace notes. El guit (Electric guitar) is mostly silent. Pno (Piano) plays a complex melodic and harmonic line. El pno (Electric piano) plays a sustained chord. Synth (Synthesizer) plays a sustained chord. The score is written in a standard musical notation with a grand staff for each instrument.

62

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

Measure 62: Clk R has a sequence of notes starting with a rest, followed by a quarter note, a quarter rest, and a quarter note. Clk L has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Kick R has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Kick L has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Vib 1 has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Vib 2 has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. St guit has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. El guit has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Pno has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. El pno has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note. Synth has a sequence of notes starting with a quarter note, followed by a quarter rest, and a quarter note.

65

This musical score page contains measures 65, 66, and 67 of the piece 'Gorge'. The score is written for a multi-instrument ensemble. Measures 65 and 66 are marked with a repeat sign. The instruments and their parts are as follows:

- Clk R (Clock Right):** Features a rhythmic pattern of eighth and sixteenth notes.
- Clk L (Clock Left):** Features a rhythmic pattern of eighth and sixteenth notes.
- Kick R (Kick Right):** Features a rhythmic pattern of eighth and sixteenth notes.
- Kick L (Kick Left):** Features a rhythmic pattern of eighth and sixteenth notes.
- Vib 1 (Vibraphone 1):** Features a melodic line with a grace note in measure 66.
- Vib 2 (Vibraphone 2):** Features a melodic line with a grace note in measure 66.
- St guit (Steel Guitar):** Features a melodic line with a grace note in measure 66.
- El guit (Electric Guitar):** Features a melodic line with a grace note in measure 66.
- Pno (Piano):** Features a complex melodic and harmonic line.
- El pno (Electric Piano):** Features a melodic line with a grace note in measure 66.
- Synth (Synthesizer):** Features a melodic line with a grace note in measure 66.

The score is written in a key signature of three sharps (F#, C#, G#) and a 4/4 time signature. The measures are marked with a repeat sign, indicating that measures 65 and 66 are repeated.

68

This musical score page contains two measures of music, numbered 68 and 69. The score is arranged in a multi-stem format with the following parts from top to bottom: Clk R, Clk L, Kick R, Kick L, Vib 1, Vib 2, St guit, El guit, Pno, El pno, and Synth. Measures 68 and 69 are grouped by a brace on the left. The key signature has four sharps (F#, C#, G#, D#). The Clk parts use a 16th-note pulse. The Kick parts use a 16th-note pulse. The Vib 1 part has a melodic line in measure 68. The Vib 2 part has a sustained chord in measure 68. The St guit part has a melodic line in measure 68. The El guit part has a sustained chord in measure 68. The Pno part has a melodic line in measure 68. The El pno part has a melodic line in measure 68. The Synth part has a melodic line in measure 68.

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

70

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

72 05:45

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

75

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

77

Clk R

Clk L

Kick R

Kick L

Vib 1

Vib 2

St guit

El guit

Pno

El pno

Synth

2.Woods Canon 1

Woods Canon 1 transitions from Field recording 2:

Field recording 2: Woodland path 1 (Sherwood Pines) [05:59-06:45]

- Footsteps along a forest path
- Gentle breeze
- Fade out from Woods Canon 1 entry at 06:27

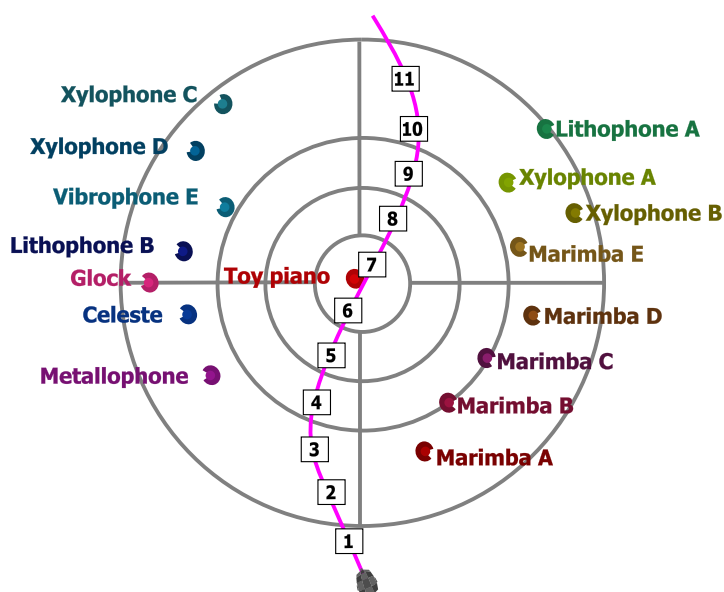
The listener follows a serpentine route through the sources.

Each pitch is played by a separate instrument as listed below.

They are displayed in the score as a piano reduction labelled 'pitch part'.

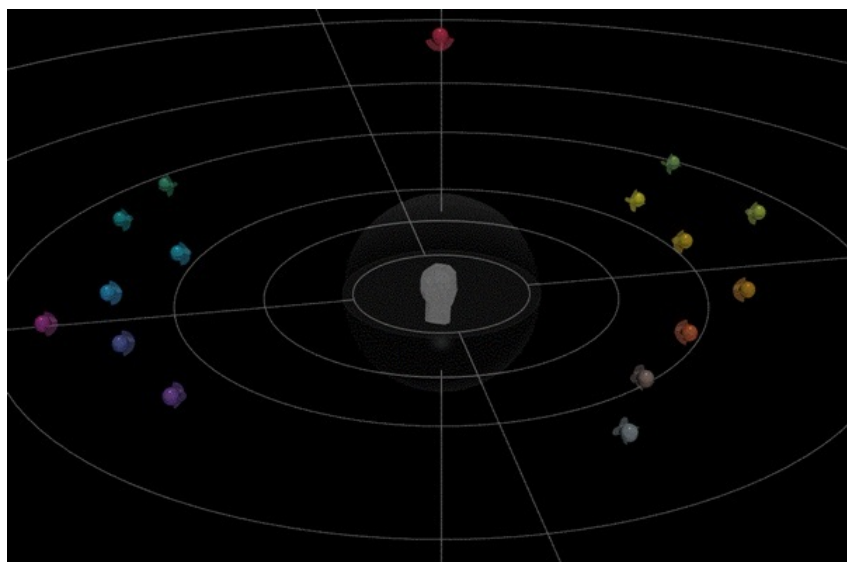
The full canon part is shown simply for reference.

Sources are placed at head height apart from the toy piano which is elevated.



Pitch part instruments:

C3	Toy Piano
Eb3	Glock
F3	Metallophone
G3	Celeste
G#3	Lithophone B
Bb3	Vibraphone E
C4	Xylophone D
D4	Xylophone C
Eb4	Lithophone A
F4	Xylophone B
G4	Xylophone A
G#4	Marimba E
Bb4	Marimba D
C5	Marimba C
D5	Marimba B
Eb5	Marimba A



Woods Canon 1 part (for reference):

Three staves of musical notation for the reference part of Woods Canon 1. The first staff is in bass clef, 6/4 time, with a key signature of three flats (B-flat, E-flat, A-flat). It contains two measures of music. The second staff is in treble clef, 6/4 time, with a key signature of three flats. It contains two measures of music, starting with a measure number '3' above the staff. The third staff is in treble clef, 6/4 time, with a key signature of three flats. It contains one measure of music, starting with a measure number '6' above the staff, and ends with a double bar line.

2. Woods Canon 1

Three staves of musical notation for the second part of Woods Canon 1. The first staff is labeled 'Pitch part' and is in bass clef, 6/4 time, with a key signature of three flats. It contains two measures of music. Above the first measure is a tempo marking '♩ = 100' and a time signature box containing '06:27'. The second staff is labeled 'Pitch' and is in treble clef, 6/4 time, with a key signature of three flats. It contains two measures of music, starting with a measure number '3' above the staff. The third staff is labeled 'Pitch' and is in treble clef, 6/4 time, with a key signature of three flats. It contains two measures of music, starting with a measure number '5' above the staff.

6

Pitch

Measures 6 and 7 of the piece. Measure 6 features a complex texture with multiple overlapping chords and melodic lines in both the treble and bass staves, connected by a large slur. Measure 7 continues this texture with similar overlapping figures.

7

Pitch

Measures 8 and 9. Measure 8 shows a continuation of the complex texture from the previous measures. Measure 9 introduces a more rhythmic pattern with eighth notes in the treble staff and rests in the bass staff.

9

Pitch

Measures 10 and 11. Measure 10 features a melodic line in the treble staff and a single note in the bass staff. Measure 11 continues the melodic line in the treble staff and has a single note in the bass staff.

11

Pitch

Measures 12 and 13. Measure 12 shows a melodic line in the treble staff and a single note in the bass staff. Measure 13 continues the melodic line in the treble staff and has a single note in the bass staff.

3.Woods Canon 2

The listener, again, follows a serpentine route through the sources.

Sources are placed at head height.

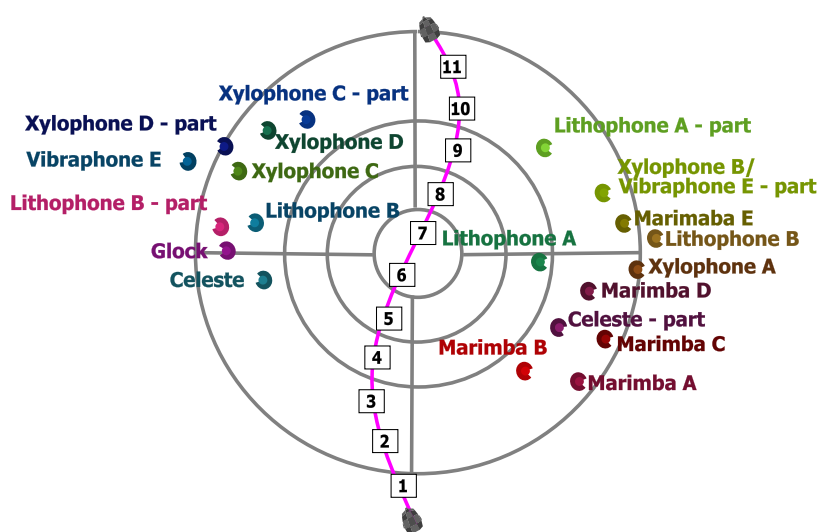
As with Canon 1, a pitch part has each pitch played by a separate instrument as listed below.

Additionally, there are six instruments which play the full canon:

- pt 1 - Lithophone A
- pt 2 - Xylophone C
- pt 3 - Xylophone D
- pt 4 - Vibraphone E
- pt 5 - Lithophone B
- pt 6 - Celeste

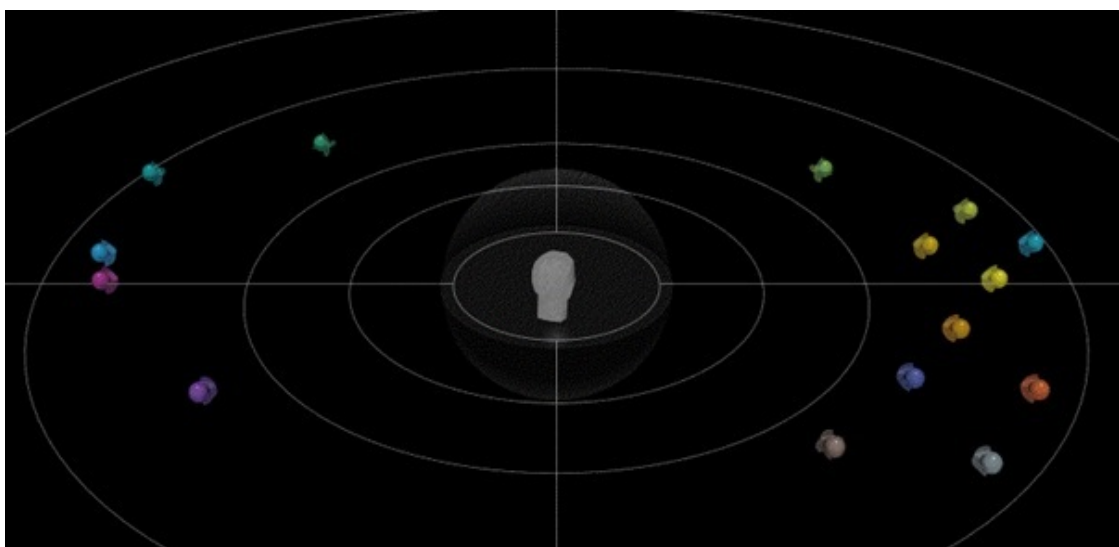
These are named below as 'part' sources.

One source shares a part and pitch: Vibraphone E - part and Xylophone B - pitch.



Pitch part instruments:

G#2	Glock
Bb2	Metallophone
B2	Celeste
B3	Lithophone B
Db3	Vibraphone E
Eb3	Xylophone D
F3	Xylophone C
F#3	Lithophone A
G#3	Xylophone B
Bb3	Xylophone A
Db4	Marimba E
Eb4	Marimba D
F4	Marimba C
F#4	Marimba B
G#4	Marimba A



3.Woods Canon 2

36

$\text{♩} = 100$ 07:07

Pitch part

Lithophone A

Xylophone C

Xylophone D

Vibraphone E

Lithophone B

Celeste

The musical score is written for a percussion ensemble. The top staff, labeled 'Pitch part', is in treble clef and shows a melodic line with a half note, a quarter note, and a half note. The bottom five staves are in bass clef and show rhythmic patterns for Lithophone A, Xylophone C, Xylophone D, Vibraphone E, and Lithophone B. The Celeste part is also in bass clef and shows a rhythmic pattern. The score is in 4/4 time and has a key signature of five flats. The tempo is marked as $\text{♩} = 100$ and the time signature is 07:07.

3

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score is for a piece titled "Woods Canon 2" on page 37. It consists of six staves. The first staff, labeled "Pitch", is a grand staff with a treble and bass clef, featuring a triplet of eighth notes in the first measure. The second staff, labeled "Lit A", is a treble clef staff with a melodic line. The third staff, labeled "Xy C", is a bass clef staff with a melodic line. The fourth staff, labeled "Xy D", is a bass clef staff with a melodic line. The fifth staff, labeled "Vib E", is a bass clef staff with a melodic line. The sixth staff, labeled "Lit B", is a bass clef staff with whole rests in both measures. The seventh staff, labeled "Cel", is a bass clef staff with whole rests in both measures. The key signature is B-flat major (two flats). The time signature is not explicitly shown but appears to be 4/4 based on the note values.

5

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score for 'Woods Canon 2' on page 38 consists of six staves. The first staff, labeled 'Pitch', is a grand staff with a treble and bass clef, starting with a measure number '5'. The subsequent staves are 'Lit A' (treble clef), 'Xy C' (treble clef), 'Xy D' (treble clef), 'Vib E' (bass clef), 'Lit B' (bass clef), and 'Cel' (bass clef). The key signature for all staves is B-flat major, indicated by two flats (B-flat and E-flat). The 'Vib E' staff concludes with a treble clef. The 'Cel' staff features a whole rest in its first measure.

6

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score for 'Woods Canon 2' is presented on six staves. The top staff, labeled 'Pitch', is a grand staff with a treble clef on the upper staff and a bass clef on the lower staff. It contains a complex arrangement of beamed eighth and sixteenth notes, with several slurs and ties. The remaining five staves are single-line staves: 'Lit A' (bass clef), 'Xy C' (treble clef), 'Xy D' (treble clef), 'Vib E' (treble clef), and 'Lit B' (bass clef). The bottom staff, 'Cel', is also a single-line staff with a bass clef. The key signature for the entire piece is three flats (B-flat, E-flat, A-flat), and the time signature is 6/8. The notation includes various rhythmic values, primarily eighth and sixteenth notes, often beamed together, and some slurs and ties.

7

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score for "Woods Canon 2" on page 40 consists of six staves. The first staff, labeled "Pitch", is a grand staff (treble and bass clef) and begins with a measure number "7". It contains a complex melody with many beamed notes and slurs. The second staff, labeled "Lit A", is a single bass staff and contains mostly rests. The third staff, labeled "Xy C", is a single bass staff and contains a simple melody. The fourth staff, labeled "Xy D", is a single treble staff and contains a simple melody. The fifth staff, labeled "Vib E", is a single treble staff and contains a simple melody. The sixth staff, labeled "Lit B", is a single treble staff and contains a simple melody. The seventh staff, labeled "Cel", is a single bass staff and contains a simple melody. The key signature is B-flat major (two flats). The time signature is not explicitly shown but appears to be common time (C).

8

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score for 'Woods Canon 2' on page 41 consists of seven staves. The top staff, labeled 'Pitch', is a grand staff with a treble and bass clef, containing a measure number '8' above the first measure. The subsequent staves are labeled 'Lit A', 'Xy C', 'Xy D', 'Vib E', 'Lit B', and 'Cel' from top to bottom. The key signature is B-flat major (two flats). The time signature is 4/4. The 'Lit A' and 'Xy C' staves have whole rests in the first measure. The 'Xy D', 'Vib E', 'Lit B', and 'Cel' staves have eighth and quarter notes in the first measure. The second measure continues the melody for all instruments.

10

Pitch

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

The musical score for 'Woods Canon 2' on page 42 consists of seven staves. The key signature is B-flat major (two flats). The 'Pitch' staff, starting at measure 10, uses a treble clef and contains a melody with several rests and a final eighth note. The 'Lit A', 'Xy C', 'Xy D', and 'Vib E' staves are silent, each marked with a bass clef. The 'Lit B' and 'Cel' staves play a melody in the bass clef, with 'Cel' transitioning to a treble clef in the second measure. The score ends with a double bar line.

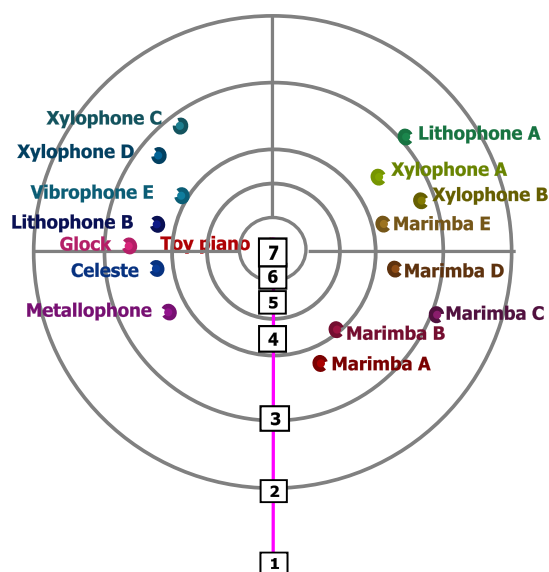
4.Woods Canon 3(i)

Canon 3(i) is similar to Canon 2 in that there is both a pitch part and a series of instruments playing the full canon, though in this case, all 16 instruments play the full canon in turn.

Pitches and parts share sources.

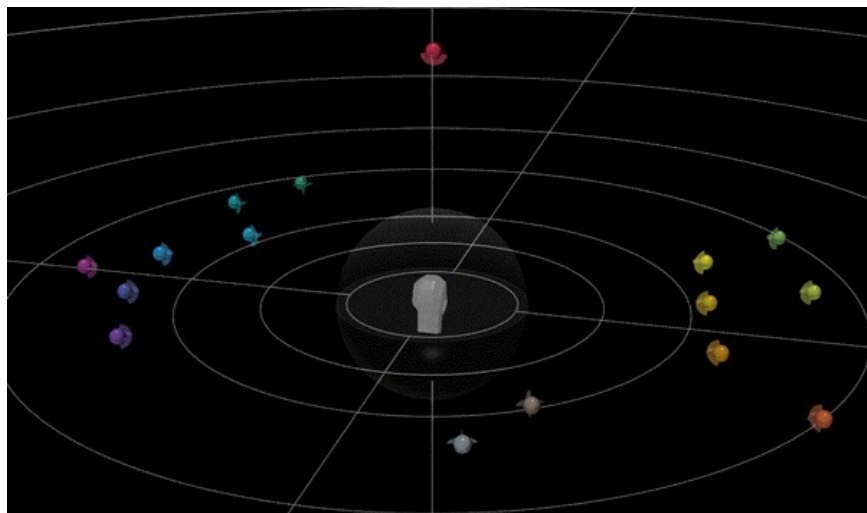
From bar 1 the listener approaches the centre of the sources gradually slowing to a halt by bar 7.

Sources are placed at head height apart from the toy piano which is elevated.



Pitch part instruments:

E3	Toy Piano
F#3	Glock
G3	Metallophone
A3	Celeste
B3	Lithophone B
C4	Vibraphone E
D4	Xylophone D
E4	Xylophone C
F#4	Lithophone A
G4	Xylophone B
A4	Xylophone A
B4	Marimba E
C5	Marimba D
D5	Marimba C
E5	Marimba B
G5	Marimba A



4.Woods Canon 3(i)

44

♩ = 100

07:47

Pitch part

Marimba A

Marimba B

Marimba C

Marimba D

Marimba E

Xylophone A

Xylophone B

Lithophone A

Xylophone C

Xylophone D

Vibraphone E

Lithophone B

Celeste

Metallophone

Glock

Toy Piano

3

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble, including a Pitch ensemble, Maracas (Mar A-E), Xylophones (Xy A-D), Vibraphone (Vib E), Liturgical instruments (Lit A-B), Cello (Cel), Metallophone (Met), Gong (Gl), and Timpani (T Pno). The music is in 3/4 time, as indicated by the "3" above the first measure. The key signature has three sharps (F#, C#, G#). The Pitch ensemble part features a complex, multi-measure rest followed by a series of chords. The Maracas and Xylophones play a rhythmic pattern of eighth and sixteenth notes. The other instruments (Vibraphone, Liturgical instruments, Cello, Metallophone, Gong, and Timpani) are marked with a "x" in the first measure, indicating they are to be played but their specific parts are not written out in this section.

5

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble, including a Pitch ensemble, five Maracas (Mar A-E), five Xylophones (Xy A-E), five Liturgical instruments (Lit A-E), five Vibraphones (Vib A-E), five Cymbals (Cel A-E), five Metallophones (Met A-E), five Gongs (Gl A-E), and a Timpani (T Pno). The key signature is three sharps (F#, C#, G#), and the time signature is 4/4. The score is divided into measures, with a measure number "5" indicated at the beginning of the first staff. The Pitch ensemble part is written for a large group of instruments, with a complex, multi-measure rest in the first measure. The Maracas and Xylophones have melodic lines, while the Liturgical instruments, Vibraphones, Cymbals, Metallophones, Gongs, and Timpani have multi-measure rests in the first measure.

6

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble, including a Pitch ensemble, five Maracas (Mar A-E), five Xylophones (Xy A-E), five Liturgical instruments (Lit A-E), five Vibraphones (Vib A-E), five Cymbals (Cel A-E), five Metallophones (Met A-E), five Gongs (Gl A-E), and a Timpani (T Pno). The score is written in 2/4 time and features a key signature of three sharps (F#, C#, G#). The Pitch ensemble part is written in a grand staff (treble and bass clefs) and features a complex, multi-measure rest of 6 measures. The other instruments have various melodic lines and rests. The score is written in a standard musical notation style with a large, clear font for the instrument names and a smaller font for the measure numbers.

7

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

8

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble, including a Pitch ensemble, Maracas (Mar A, B, C, D, E), Xylophones (Xy A, B, C, D), Vibraphone (Vib E), Liturgical instruments (Lit A, B), Cello (Cel), Metallophone (Met), Gong (Gl), and Timpani (T Pno). The key signature is three sharps (F#, C#, G#), and the time signature is 4/4. The score begins with a measure marked with a large "8" above the Pitch staff. The Pitch ensemble part is written in a grand staff (treble and bass clefs) and features complex, overlapping melodic lines. The other instruments have more straightforward parts, with many of them (Xy C, Xy D, Vib E, Lit B, Cel, Met, Gl, T Pno) playing sustained notes or rests throughout the piece. The notation includes various musical symbols such as notes, rests, beams, and slurs.

9

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

10

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

11

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

12

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

13

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble of instruments. At the top, a grand staff labeled "Pitch" contains two staves with complex, dense musical notation, including many beamed notes and slurs. Below this, there are 13 individual staves, each labeled with an instrument name on the left. The instruments are: Mar A, Mar B, Mar C, Mar D, Mar E, Xy A, Xy B, Lit A, Xy C, Xy D, Vib E, Lit B, Cel, Met, Gl, and T Pno. The notation for these instruments is more sparse than the "Pitch" part, featuring various note values, rests, and slurs. The key signature for all staves is three sharps (F#, C#, G#). The measure number "13" is written above the first staff of the "Pitch" part.

14

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble of instruments. At the top, a grand staff labeled "Pitch" contains two staves with complex, overlapping melodic lines. Below this, there are ten individual staves for various instruments: Mar A, Mar B, Mar C, Mar D, Mar E, Xy A, Xy B, Lit A, Xy C, Xy D, Vib E, Lit B, Cel, Met, Gl, and T Pno. The instruments are arranged in a way that suggests a woodwind and percussion ensemble. The key signature is three sharps (F#, C#, G#), and the time signature is not explicitly shown but appears to be common time. The score is marked with a "14" at the beginning of the first staff. The notation includes various musical symbols such as notes, rests, and beams, indicating a complex and rhythmic composition.

15

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

16

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble of instruments. At the top, a grand staff labeled "Pitch" contains two staves with complex, overlapping melodic lines. Below this, there are ten staves for woodwinds: Mar A, Mar B, Mar C, Mar D, Mar E, Xy A, Xy B, Lit A, Xy C, and Xy D. These woodwinds are mostly silent, indicated by rests. The bottom section of the score includes staves for Vib E, Lit B, Cel, Met, Gl, and T Pno. These instruments have more active parts, with various note values and rests. The key signature is three sharps (F#, C#, G#), and the time signature is not explicitly shown but appears to be common time. The score is numbered 16 at the beginning of the first staff.

17

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

18

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

The image shows a musical score for a piece titled "Woods Canon 3(i)". The score is written for a large ensemble, including a Pitch ensemble, five Maracas (Mar A-E), five Xylophones (Xy A-E), five Liturgical instruments (Lit A-E), and a Percussion section (Cel, Met, Gl, T Pno). The music is in 4/4 time and features a complex, layered texture. The Pitch ensemble plays a melodic line in the upper register, while the other instruments provide a rhythmic and harmonic foundation. The score is divided into two systems, with the first system starting at measure 18. The notation includes various musical symbols such as notes, rests, and dynamic markings.

20

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

22

Pitch

Mar A

Mar B

Mar C

Mar D

Mar E

Xy A

Xy B

Lit A

Xy C

Xy D

Vib E

Lit B

Cel

Met

Gl

T Pno

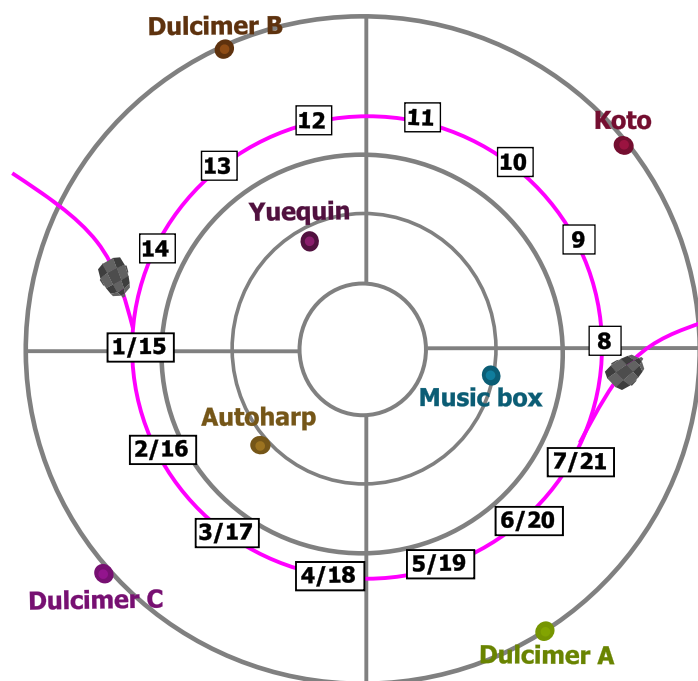
5.Woods Canon 3(ii)

Canon 3(ii) is played mainly by stringed instruments.

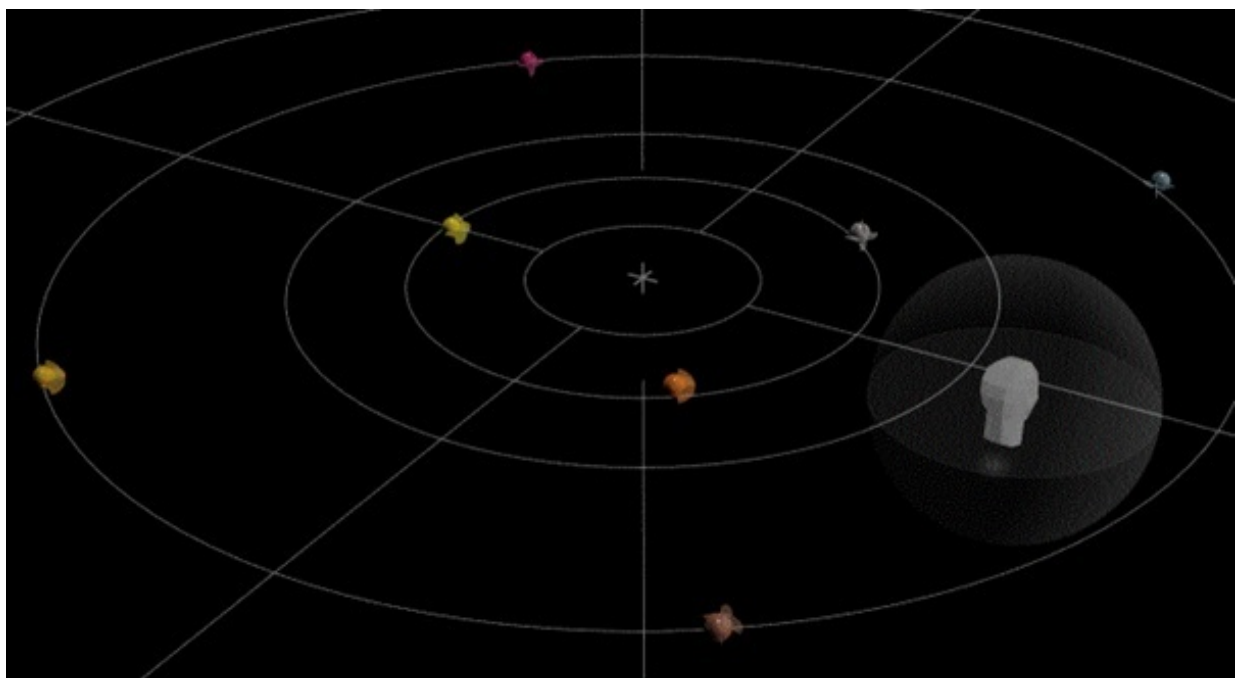
There is no pitch part; the full canon is played by the seven instruments listed below.

The listener follows a circular route among the sources effectively making one and a half revolutions.

Sources are placed at head height.



- pt 1 - Music Box
- pt 2 - Koto
- pt 3 - Yuequin
- pt 4 - Dulcimer B
- pt 5 - Autoharp
- pt 6 - Dulcimer C
- pt 7 - Dulcimer A



5.Woods Canon 3(ii)

♩ = 100

09:06

Music box

Koto

Yuequin

Dulcimer B

Autoharp

Dulcimer C

Dulcimer A

The musical score is written for seven instruments, each on a five-line staff with a treble clef and a key signature of three sharps (F#, C#, G#). The time signature is 6/4. The tempo is indicated as ♩ = 100. A rehearsal mark '09:06' is located above the Koto staff. The Music box and Koto have melodic lines, while the Yuequin, Dulcimer B, Autoharp, Dulcimer C, and Dulcimer A have rests.

Music box: $\text{F}\sharp_4$ (quarter), $\text{A}\sharp_4$ (quarter), $\text{B}\sharp_4$ (quarter), $\text{C}\sharp_5$ (quarter), $\text{D}\sharp_5$ (quarter), E_6 (half).

Koto: $\text{F}\sharp_4$ (quarter), $\text{A}\sharp_4$ (quarter), $\text{B}\sharp_4$ (quarter), $\text{C}\sharp_5$ (quarter), $\text{D}\sharp_5$ (quarter), E_6 (half).

Yuequin: Rest.

Dulcimer B: Rest.

Autoharp: Rest.

Dulcimer C: Rest.

Dulcimer A: Rest.

3

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

The musical score is written for seven instruments: M box, Koto, Yue, Dul B, Aut, Dul C, and Dul A. The key signature is three sharps (F#, C#, G#). The score is divided into two measures. The first measure features a triplet of eighth notes in the M box part, followed by a quarter note. The Koto, Yue, and Dul B parts have a dotted quarter note followed by an eighth note. The Aut, Dul C, and Dul A parts have a whole rest. The second measure features a quarter note followed by a quarter rest in the M box part. The Koto, Yue, and Dul B parts have a dotted quarter note followed by an eighth note. The Aut, Dul C, and Dul A parts have a whole rest.

5

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

The musical score is written for seven instruments: M box, Koto, Yue, Dul B, Aut, Dul C, and Dul A. The key signature is three sharps (F#, C#, G#). The M box part starts with a measure marked '5'. The Koto part has a measure with a 7-measure rest. The Yue part has a measure with a 7-measure rest. The Dul B and Aut parts have a measure with a 7-measure rest. The Dul C and Dul A parts have a measure with a 7-measure rest. The score is divided into two measures by a vertical line.

7

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

9

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

The musical score is written for seven instruments: M box, Koto, Yue, Dul B, Aut, Dul C, and Dul A. The key signature is three sharps (F#, C#, G#). The score is divided into two measures. The M box, Koto, Yue, Dul B, and Aut parts have continuous melodic lines. The Dul C and Dul A parts have a more rhythmic, dotted pattern. A bracket on the left groups all instruments, and a measure rest '9' is at the top left.

11

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

13

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

15

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

17

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

19

M box

Koto

Yue

Dul B

Aut

Dul C

Dul A

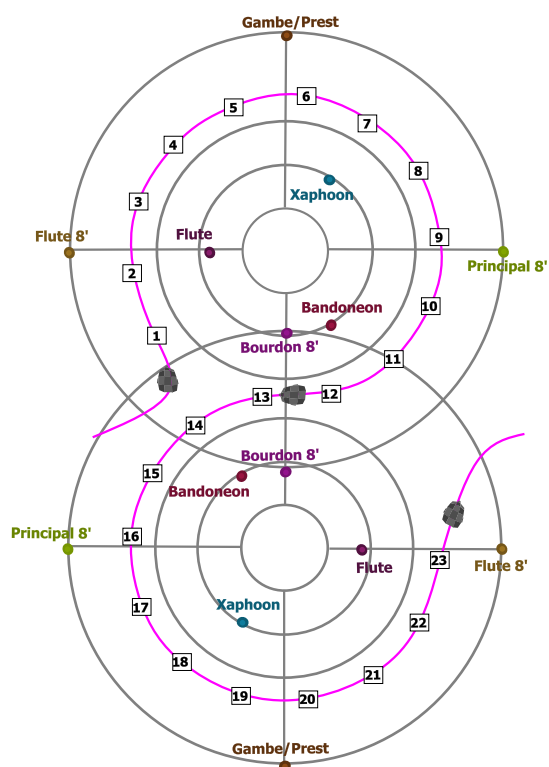
6.Woods Canon 3(iii)

Canon 3(iii) is played by aerophones.

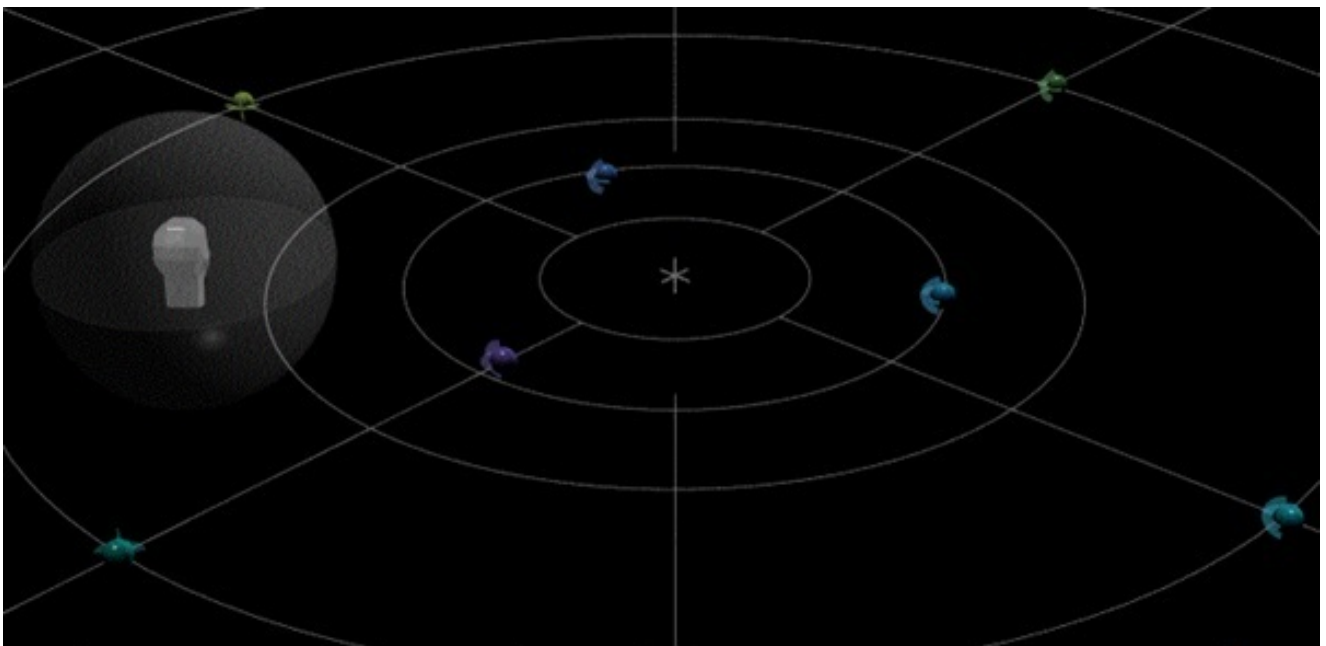
There is no pitch part; the full canon is played by all seven instruments, but after bar 16, they become tacit in reverse order of introduction.

The listener effectively describes a figure of eight around two rooms.

Sources are placed at head height.



- pt 1 - Flute
- pt 2 - Xaphoon
- pt 3 - Bandoneon
- pt 4 - Bourdon 8'
- pt 5 - Flute 8'
- pt 6 - Principal 8'
- pt 7 - Gambe/Prest 8'



6.Woods Canon 3(iii)

♩ = 100 10:18

Flute

Xaphoon

Bandoneon

Bourdon 8'

Flute 8'

Principal 8'

Gambe/Prest 8'

The musical score is written for seven instruments, all in treble clef with a key signature of three sharps (F#, C#, G#) and a 6/4 time signature. The tempo is marked as quarter note = 100, and the total duration is 10:18. The Flute part begins with a melodic line in the first measure, while the other instruments have rests. The second measure shows the Xaphoon and Flute 8' parts with similar melodic lines, while the others remain at rest.

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

3

The musical score is for a piece titled "Woods Canon 3(iii)". It features seven staves, each with a treble clef and a key signature of three sharps (F#, C#, G#). The staves are labeled on the left: Fl (Flute), Xp (Xylophone), Bnd (Bamboo Flute), Bou 8 (Bassoon 8), Fl 8 (Flute 8), Pr 8 (Percussion 8), and Gm/Pr 8 (Guitar/Percussion 8). The score is divided into two measures. The first measure contains a triplet of eighth notes in the Fl staff, followed by a quarter note, and then a half note. The Xp, Bnd, Bou 8, Fl 8, Pr 8, and Gm/Pr 8 staves all have a whole rest in the first measure. The second measure contains a quarter note, a half note, and a quarter note in the Fl staff, followed by a quarter note, a half note, and a quarter note in the Xp, Bnd, Bou 8, Fl 8, Pr 8, and Gm/Pr 8 staves. The Bou 8, Fl 8, Pr 8, and Gm/Pr 8 staves have a whole rest in the second measure.

5

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

7

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

9

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

11

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

13

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

15

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

17

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

19

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

21

Fl

Xp

Bnd

Bou 8

Fl 8

Pr 8

Gm/Pr 8

A musical score for a woodwind ensemble. The score is for measures 21, 22, and 23. The instruments listed on the left are Flute (Fl), Xylophone (Xp), Bannister (Bnd), Bouquet (Bou 8), Flute 8 (Fl 8), Percussion 8 (Pr 8), and Gong/Drum (Gm/Pr 8). The key signature is three sharps (F#, C#, G#). The Flute part has a melodic line in measure 21, while the other instruments have rests. In measures 22 and 23, all instruments have rests. The score is written on a grand staff with seven staves.

7.Lake

Lake transitions from Field recording 3:

Field recording 3: Woodland path 2 (Creswell Crags) [11:28-11:59]

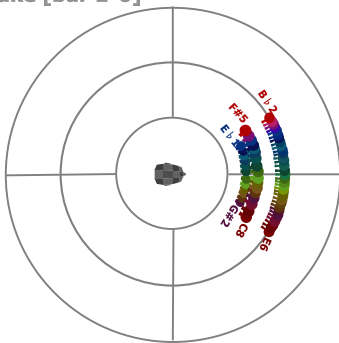
- Flowing water
- Bird chatter
- Fade out from Lake entry at 11:47

Lake is once again a pitch part, with each pitch played by a separate virtual instrument emanating from a single source, nevertheless, all representing a single piano.

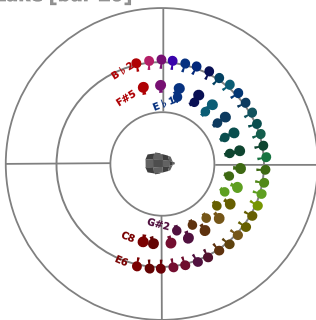
The sources are placed at three levels in relation to the listener: with higher pitches elevated, mid-pitches at head-height and bass pitches below.

The listener remains stationary as the sources gradually encircle the listening position. Only the end pitches of each source row are labelled.

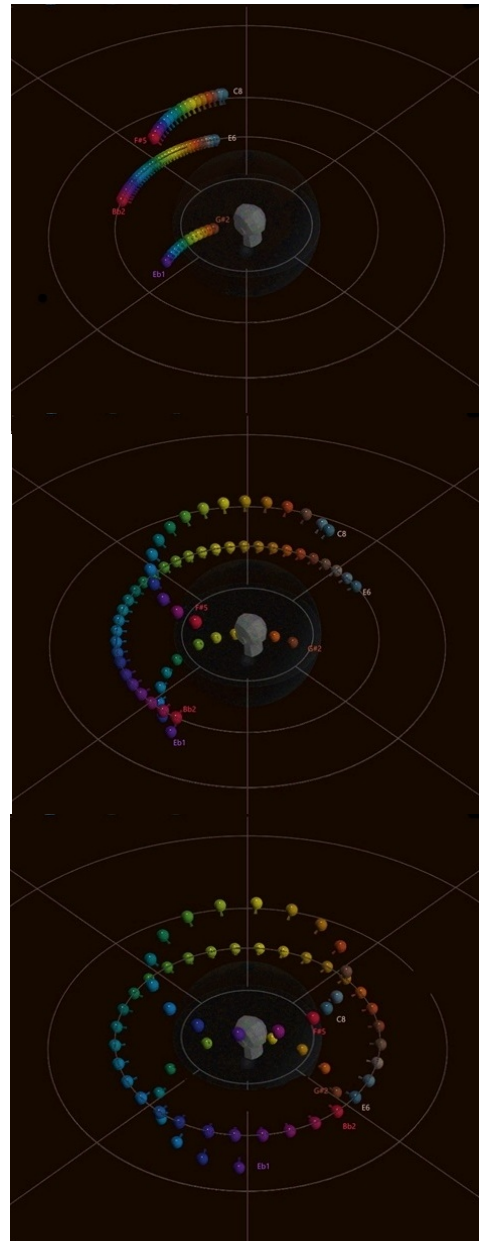
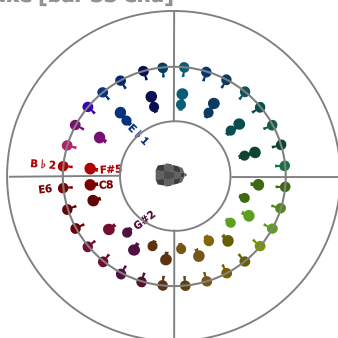
Lake [bar 1-6]



Lake [bar 20]



Lake [bar 33 end]



7.Lake

♩ = 80 11:45 B♭ E♭ F7/E♭

Piano

Organ

This musical system contains the first three measures of the piece. The Piano part is written in a grand staff (treble and bass clefs) with a key signature of two flats (B♭ and E♭) and a 4/4 time signature. The tempo is marked as ♩ = 80. A rehearsal mark is placed at the beginning of the first measure, with the time 11:45. The first measure is mostly rests, with a half note G3 in the bass staff. The second measure features a half note G3 in the bass staff and a half note A3 in the treble staff. The third measure has a half note G3 in the bass staff and a half note A3 in the treble staff. The Organ part is also in a grand staff and remains mostly silent throughout these three measures.

4

Pno

Org

This musical system contains measures 4 through 6. The Piano part continues with a half note G3 in the bass staff and a half note A3 in the treble staff in measure 4. In measure 5, the bass staff has a half note G3 and the treble staff has a half note A3. In measure 6, the bass staff has a half note G3 and the treble staff has a half note A3. The Organ part remains mostly silent throughout these measures.

8

Cm9
Bb

Pno

Org

12:19

10⁸ Ebmaj7 Ab Bb/Ab Dbmaj9 Gm7 Cm13

Pnc

Org

This musical score is for measures 10 through 13 of a piece. The key signature has three flats (Bb, Eb, Ab). The time signature is 8/8. The score is divided into two parts: Piano (Pnc) and Organ (Org). The Piano part consists of six staves. The first four staves are grouped by a brace on the left. The fifth and sixth staves are separate. The Organ part consists of two staves, also grouped by a brace on the left. Chord symbols are placed above the first four measures: Ebmaj7, Ab, Bb/Ab, Dbmaj9, Gm7, and Cm13. The Piano part features various musical notations including eighth notes, quarter notes, half notes, and chords. The Organ part is mostly silent, with some sustained notes in the first measure of measure 10.

14⁸ Cm13 Am7 Dm7 Eb Ab6 Db

Pno

Org

The musical score is for the piece "Lake" on page 89. It is written for Piano (Pno) and Organ (Org) in 5/4 time. The key signature has four flats (Bb, Eb, Ab, Db). The score consists of three measures. The Piano part has six staves. The Organ part has two staves. The first measure is marked with a "14" and an "8" in a superscript. The second measure is marked with "Cm13", "Am7", "Dm7", and "Eb". The third measure is marked with "Ab6" and "Db". The score includes various musical notations such as chords, single notes, and rests.

17⁸ Dbmaj9 Gb6(add9) Gb6(add9) Db11

Pnc

Org

The musical score is for a piece titled "Lake" on page 90. It is written for Piano (Pnc) and Organ (Org). The key signature is D-flat major (three flats). The time signature is 5/4. The score is divided into two systems. The first system has a 5/4 time signature, and the second system has a 4/4 time signature. The Piano part is written on six staves, and the Organ part is written on two staves. The Piano part features complex chordal textures and melodic lines, while the Organ part provides harmonic support with sustained chords and occasional melodic fragments. The score includes various musical notations such as notes, rests, and accidentals.

19 ⁸ Gbmaj7/Bb Eb Abm9 Abm9

Pnc

Org

The musical score is for the piece 'Lake' on page 91. It is written for Piano (Pnc) and Organ (Org) in 5/4 time. The score begins at measure 19. The piano part features a complex texture with many chords and moving lines. The organ part is mostly silent, with some chords in the final measures. The key signature is G-flat major (B-flat major). The tempo is marked with a '5' over the time signature.

Measures 19-22:

- Measure 19: Gbmaj7/Bb, Eb, Abm9, Abm9
- Measure 20: Gbmaj7/Bb, Eb, Abm9, Abm9
- Measure 21: Gbmaj7/Bb, Eb, Abm9, Abm9
- Measure 22: Gbmaj7/Bb, Eb, Abm9, Abm9

23⁸ A $\flat$ m9 E $\flat$ m9 D $\flat$ maj9 C $\flat$ maj9 B $\flat$ maj9 D $\flat$ maj7/A $\flat$ Gm11 Gm7(omit5)

Pno

Org

The musical score is for measures 23, 24, and 25. The key signature changes from one flat (B $\flat$) to two sharps (F $\sharp$, C $\sharp$) between measures 23 and 24. The time signature is 5/4. The Piano part (Pno) is written on five staves. The Organ part (Org) is written on two staves. The Piano part features complex chordal textures and melodic lines in both hands. The Organ part is mostly silent, with rests in all staves for all three measures.

13:05

26.8 D7^(omit5) D7 Gm7 Ebmaj9 Cm11 Abmaj7^(b5)

Pnc

Org

26.8 27 28

29 $B\flat maj7^{(b5)}$

Pno

Org

This musical score is for measures 29 through 32. It is written for Piano (Pno) and Organ (Org). The key signature has three flats (B-flat major or D-flat minor). The time signature is 4/4, with a 2/4 section in measures 30 and 31. The Piano part (measures 29-32) features a complex texture with multiple staves. In measure 29, the right hand has a whole note chord, while the left hand has a half note chord. In measure 30, the right hand has a half note chord, and the left hand has a half note chord. In measure 31, the right hand has a half note chord, and the left hand has a half note chord. In measure 32, the right hand has a half note chord, and the left hand has a half note chord. The Organ part (measures 29-32) also features a complex texture with multiple staves. In measure 29, the right hand has a whole note chord, and the left hand has a half note chord. In measure 30, the right hand has a half note chord, and the left hand has a half note chord. In measure 31, the right hand has a half note chord, and the left hand has a half note chord. In measure 32, the right hand has a half note chord, and the left hand has a half note chord.

34

Pno

Handwritten musical score for the Piano (Pno) part, measures 34-35. The score is written on six staves (three treble and three bass clefs). The key signature is three flats (B-flat, E-flat, A-flat). Measure 34 features a melodic line in the top treble staff and a complex chordal texture in the other staves. Measure 35 continues the texture with various chordal and melodic fragments. The piece concludes with a double bar line.

Org

Handwritten musical score for the Organ (Org) part, measures 34-35. The score is written on four staves (two treble and two bass clefs). The key signature is three flats (B-flat, E-flat, A-flat). Measure 34 features a melodic line in the top treble staff and a complex chordal texture in the other staves. Measure 35 continues the texture with various chordal and melodic fragments. The piece concludes with a double bar line.

8.Reflection Part 1

Reflection transitions from field recording 4:

Field recording 4: Birds (Creswell Crags) [11:28-14:09]

- Various bird calls, including prominent waterfowl
- Fade out from Reflection entry at 13:47

Reflection 1 presents heavily processed canonical material as described in the commentary. The stereo sources from this material are respatialised as shown in the following diagrams and the score indicates the underlying pitches present in the respatialisation.

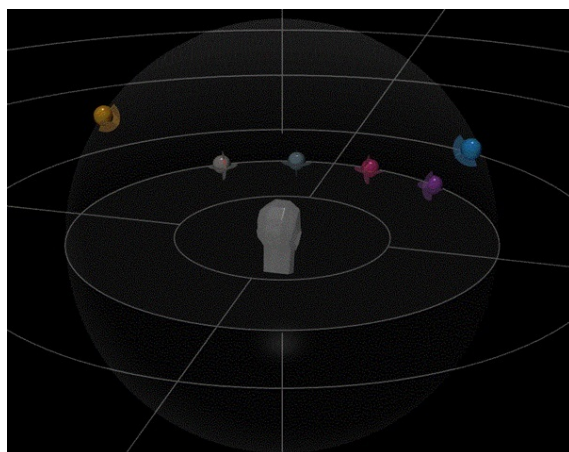
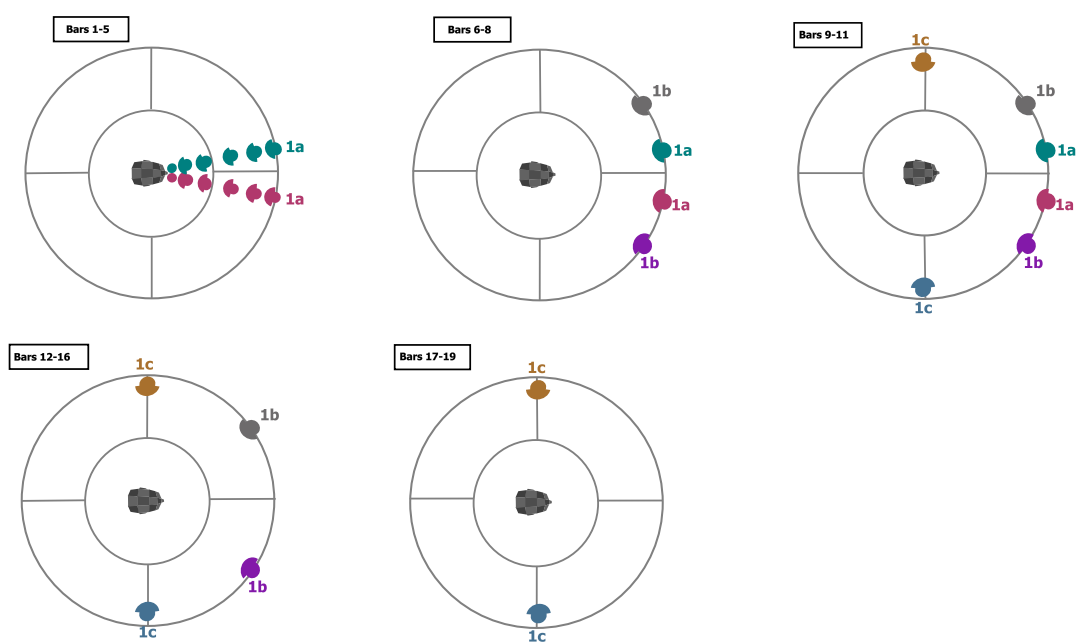
Two variations of Woods Canon 1 form the basis of Reflection 1 (1a and 1b as described in the main text).

In bars 1-6, the sources (a) move away from the listener.

From bar 6, sources (b) appear, followed by sources (c) in bar 12.

Sources (a) and (b) are level with the listener while sources (c) are elevated.

The listener remains stationary throughout the piece.



8.Reflection Part 1

♩ = 45 13:44

A

B

C

3

The musical score is for a piece titled "8.Reflection Part 1". It is written for three staves, labeled A, B, and C. The key signature is three sharps (F#, C#, G#), and the time signature is 6/4. The tempo is marked as ♩ = 45. A rehearsal mark "13:44" is present at the beginning of the first system. The first system consists of two measures. In the first measure, staff A has a melody starting on G#4, moving to A4, B4, and C5, with a triplet of eighth notes in the second measure. Staves B and C are empty. The second measure continues the melody in staff A, with notes G#4, A4, B4, and C5. Staves B and C remain empty. The second system also consists of two measures. In the first measure, staff A has a triplet of eighth notes starting on G#4, moving to A4, B4, and C5. Staves B and C are empty. The second measure continues the melody in staff A, with notes G#4, A4, B4, and C5. Staves B and C remain empty.

5

A

B

C

6

A

B

C

7

A

B

C

This system contains measures 7 and 8 of the piece. Part A (piano) features a complex texture with many beamed sixteenth notes in both staves, including grace notes. Part B (piano) has a more active melody in the right hand with eighth and sixteenth notes, while the left hand provides a steady accompaniment of eighth notes. Part C (piano) is mostly silent, with only a few notes in the bass staff in measure 8.

9

A

B

C

This system contains measures 9 and 10. Part A (piano) continues with beamed sixteenth notes in the right hand and a few notes in the left hand. Part B (piano) has a flowing melody in the right hand with eighth notes and some ties, accompanied by eighth notes in the left hand. Part C (piano) has a simple bass line in the left hand with a few notes in the right hand in measure 10.

10

A

B

C

11

A

B

C

12

A

B

C

This system contains measures 12 and 13. Part A is a grand staff with treble and bass clefs, both containing whole rests. Part B is a grand staff with treble and bass clefs. The treble staff features a complex texture of sixteenth-note chords and sixteenth-note runs. The bass staff features a similar texture with sixteenth-note chords and runs. Part C is a grand staff with treble and bass clefs. The treble staff features a melody of eighth and sixteenth notes. The bass staff features a similar texture with sixteenth-note chords and runs.

14

A

B

C

This system contains measures 14 and 15. Part A is a grand staff with treble and bass clefs, both containing whole rests. Part B is a grand staff with treble and bass clefs. The treble staff features a melody of eighth and sixteenth notes. The bass staff features a similar texture with sixteenth-note chords and runs. Part C is a grand staff with treble and bass clefs. The treble staff features a melody of eighth and sixteenth notes. The bass staff features a similar texture with sixteenth-note chords and runs.

15

A

B

C

This system contains measures 15 and 16. Part A (treble and bass staves) has whole rests in both staves for both measures. Part B (treble and bass staves) has a melodic line in the treble staff and a whole rest in the bass staff for both measures. Part C (treble and bass staves) has a complex, fast-moving accompaniment in both staves for both measures, featuring many beamed sixteenth notes and slurs.

17

A

B

C

This system contains measures 17 and 18. Part A (treble and bass staves) has whole rests in both staves for both measures. Part B (treble and bass staves) has whole rests in both staves for both measures. Part C (treble and bass staves) has a melodic line in the treble staff and a simple accompaniment in the bass staff for both measures. The accompaniment in the bass staff consists of eighth notes and rests.

19

A

B

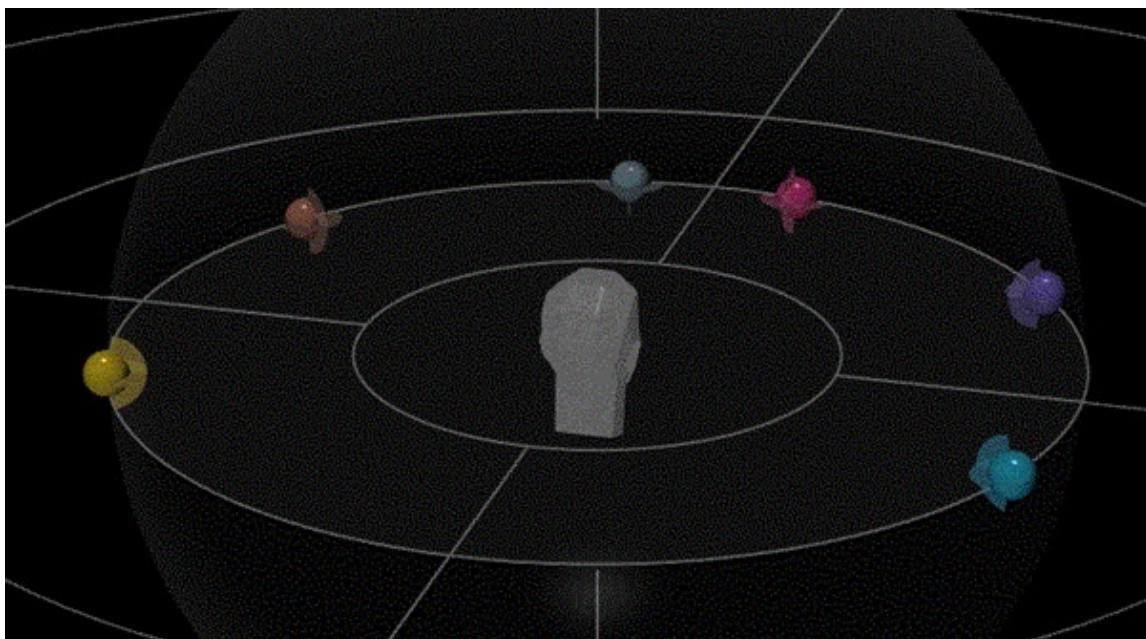
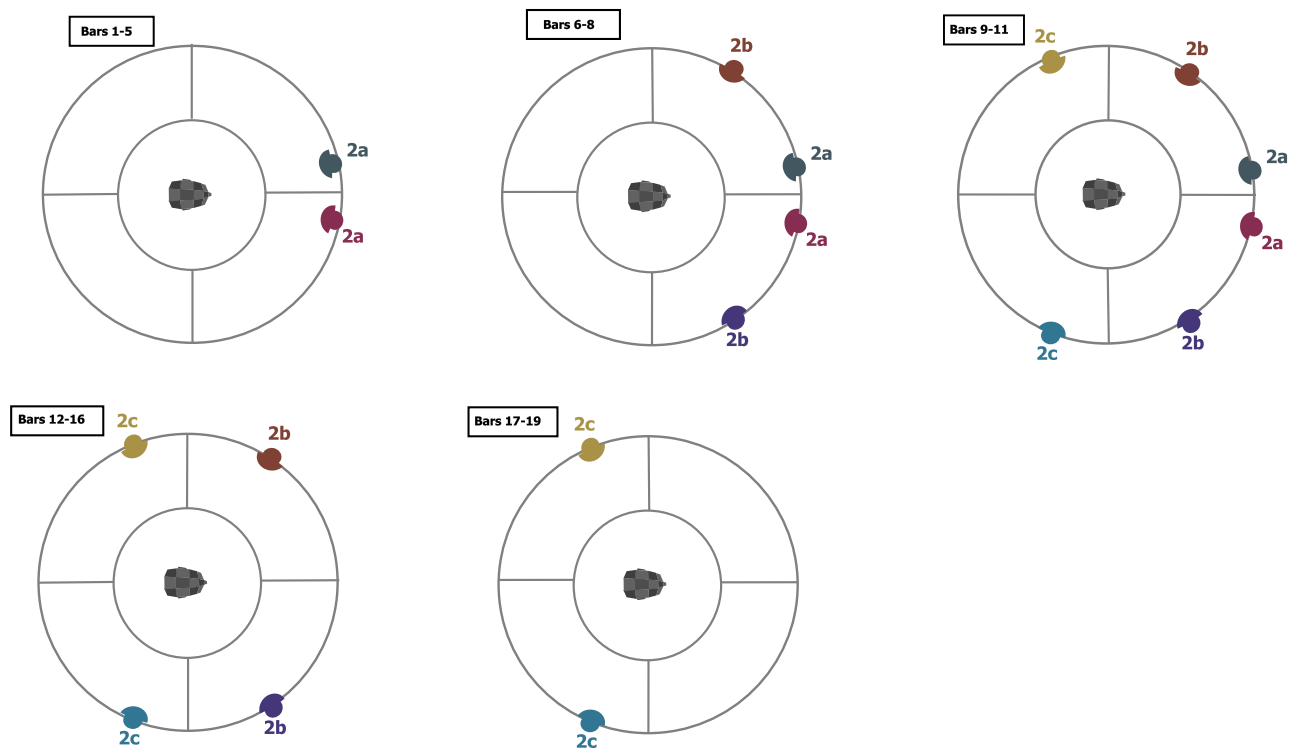
C

The image shows a musical score for three parts, labeled A, B, and C, spanning measures 19 and 20. The key signature is G major (two sharps: F# and C#). Part A and Part B are identical, consisting of whole rests in both the treble and bass staves. Part C has a melodic line in the treble staff and a whole rest in the bass staff. The melodic line in Part C starts on G4 (first space), moves to A4 (second line), B4 (second space), then has a half note G4 with a fermata, followed by F#4 (first space), E4 (first line), and D4 (first space). The score ends with a double bar line.

9.Reflection Part 2

As with Reflection part 1, part 2 is based on variations of Woods Canon 2, respatialised as shown below.

All sources are placed at head height.



9.Reflection Part 2

105

♩ = 45 18:39

A

B

C

3

A

B

C

5

A

B

C

This system contains measures 5 and 6. Part A (piano) features a complex texture with many beamed sixteenth and thirty-second notes in both staves, including a large slur spanning the entire measure. Part B (piano) has a more active melody in the right hand with eighth and sixteenth notes, while the left hand provides harmonic support with chords and moving lines. Part C (piano) is mostly static, with a single eighth-note melody in the right hand and sustained chords in the left hand.

6

A

B

C

This system contains measures 7 and 8. The musical textures for all three parts (A, B, and C) are identical to those in the first system, continuing the melodic and harmonic development of the piece.

7

A

B

C

This system contains measures 7 and 8. System A features a treble and bass staff with complex, flowing sixteenth-note passages. System B also has a treble and bass staff, with the bass staff featuring a long, continuous melodic line. System C consists of a single treble staff with sparse notes and a bass staff with block chords and short melodic fragments.

8

A

B

C

This system continues measures 7 and 8. System A and B show further development of the intricate sixteenth-note textures. System C remains sparse, with the treble staff providing harmonic support and the bass staff containing occasional notes.

9

A

B

C

This system contains measures 9 and 10. It features three staves labeled A, B, and C. Staff A (treble clef) has a melody starting on G4, moving up to A4, B4, and C5, with a final quarter note on B4. Staff B (treble clef) has a melody starting on G4, moving up to A4, B4, and C5, with a final quarter note on B4. Staff C (bass clef) has a melody starting on G3, moving up to A3, B3, and C4, with a final quarter note on B3. The bass line consists of a series of chords, mostly dyads, moving in a stepwise fashion.

10

A

B

C

This system contains measures 11 and 12. It features three staves labeled A, B, and C. Staff A (treble clef) has a melody starting on G4, moving up to A4, B4, and C5, with a final quarter note on B4. Staff B (treble clef) has a melody starting on G4, moving up to A4, B4, and C5, with a final quarter note on B4. Staff C (bass clef) has a melody starting on G3, moving up to A3, B3, and C4, with a final quarter note on B3. The bass line consists of a series of chords, mostly dyads, moving in a stepwise fashion.

11

A

B

C

This system contains measures 11 and 12. Part A (treble clef) has whole rests in both measures. Part B (treble clef) plays a melody of eighth notes in measure 11 and rests in measure 12. Part C (grand staff) plays a complex accompaniment with many beamed sixteenth notes in measure 11 and continues with a similar pattern in measure 12.

13

A

B

C

This system contains measures 13 and 14. Part A (treble clef) has whole rests in both measures. Part B (treble clef) has whole rests in both measures. Part C (grand staff) plays a melody of eighth notes in measure 13 and rests in measure 14. The accompaniment in Part C continues with beamed sixteenth notes in both measures.

15

A

B

C

The image shows a musical score for three parts, labeled A, B, and C, at measure 15. Each part is represented by a grand staff (treble and bass clefs). Part A and B are silent, indicated by whole rests in both staves. Part C has a descending eighth-note melody in the bass staff, starting on G4 and ending on D4. The treble staff for Part C is also silent, indicated by a whole rest. The measure number 15 is written above the first staff.

10.Reflection - modulation

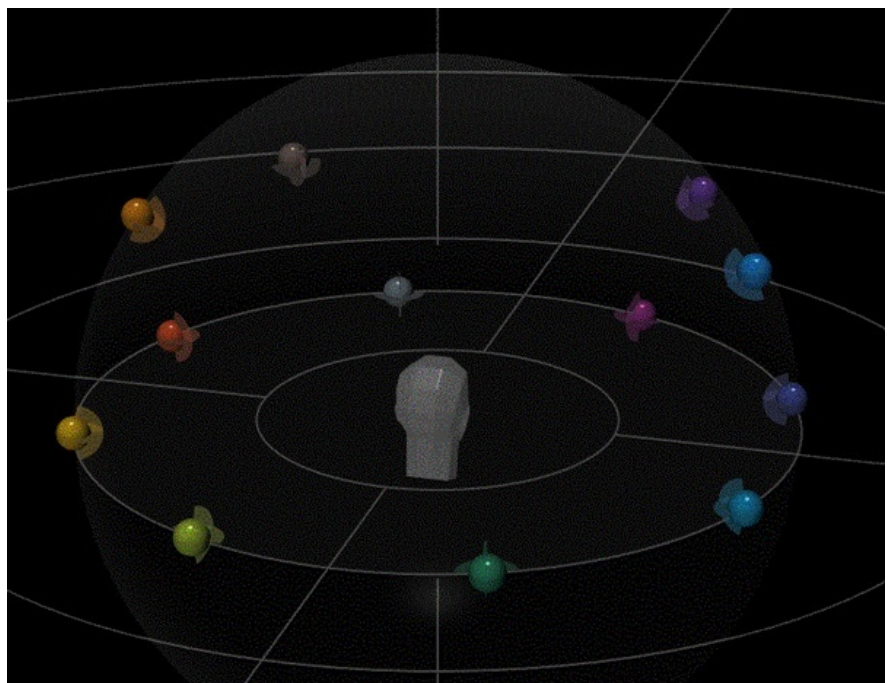
The modulation comprises two shō pairs at elevated positions.

It overlaps Reflection part 2 and part 3 and is therefore shown in two oblique views:



Reflection - modulation:
overlap with Reflection part 2

Reflection - modulation:
overlap with Reflection part 3



10.Reflection - modulation

♩ = 45 21:21

Sho 1

Sho 2

[1] 8

Sho 1

Sho 2

25:28

[1] 6

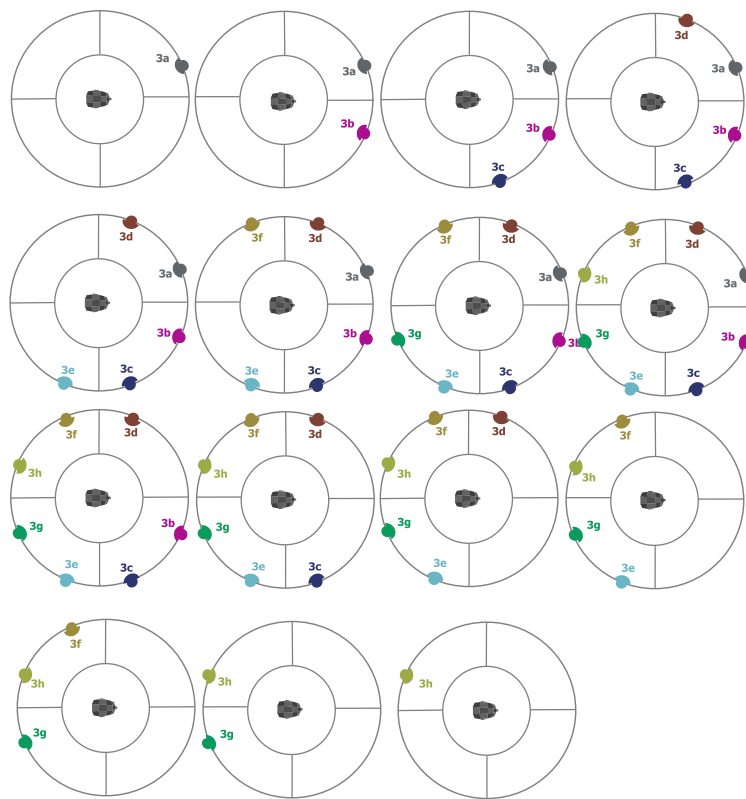
Sho 1

Sho 2

11.Reflection Part 3

Reflection part 3 respatialises elements from an extended and heavily processed version of Woods Canon 3. The material is spatialised as shown below with the score indicating the underlying, retimed pitch material.

Sources are placed at head height



11.Reflection Part 3

114

♩ = 45 23:12

A

B

C

D

E

F

G

H

3

A

B

C

D

E

F

G

H

The musical score is for a piece titled "Reflection Part 3" on page 115. It consists of eight staves, labeled A through H. The key signature is E-flat major (three flats: B-flat, E-flat, A-flat). The time signature is not explicitly shown but appears to be 4/4 based on the note values. Staff A begins with a triplet of eighth notes. Staves B, C, D, and E contain various melodic and harmonic parts, including eighth notes, quarter notes, and half notes. Staves F, G, and H are mostly empty, with some rests and occasional notes in the bass clef. The score is written in a standard musical notation style with treble and bass clefs for each staff.

5

A

B

C

D

E

F

G

H

The musical score is for eight parts, labeled A through H. Each part is written on a grand staff (treble and bass clef). The key signature is four flats (B-flat major or D-flat minor). Part A begins with a measure number 5. The notation for parts A through F includes various musical symbols such as notes, rests, and beams. Parts G and H are empty staves.

6

A

B

C

D

E

F

G

H

The musical score consists of eight staves, labeled A through H, arranged vertically. Each staff is in E-flat major, indicated by three flats (B-flat, E-flat, A-flat) in the key signature. The time signature is 4/4. Staff A begins with a measure rest, followed by a sixteenth-note triplet. Staves B through F each begin with a measure rest, followed by an eighth-note triplet. Staves G and H begin with a measure rest, followed by a quarter-note triplet. The notation includes various musical symbols such as treble and bass clefs, key signatures, time signatures, measure rests, and triplets.

7

A

B

C

D

E

F

G

H

8

A

B

C

D

E

F

G

H

The musical score consists of eight staves, labeled A through H. Each staff is in E-flat major, indicated by three flats (B-flat, E-flat, A-flat). The time signature is not explicitly shown but appears to be common time (C). The score is characterized by dense, complex textures in the upper staves (A, B, C, D) and more sparse textures in the lower staves (E, F, G, H). Staves A, B, C, and D feature many beamed notes and ties, creating a rich, layered sound. Staves E, F, G, and H provide a more sparse accompaniment, often using rests and fewer notes. The overall structure suggests a multi-part setting or a complex harmonic exercise.

9

A

B

C

D

E

F

G

H

10

A

B

C

D

E

F

G

H

11

A

B

C

D

E

F

G

H

12

A

B

C

D

E

F

G

H

This musical score, titled 'Reflection Part 3', is for an eight-part setting. It begins at measure 12. The key signature is E-flat major (three flats: B-flat, E-flat, A-flat), and the time signature is 4/4. The score is arranged in eight systems, each with a label (A through H) on the left. Each system consists of a grand staff (treble and bass clefs). The music is characterized by dense, multi-voice textures, often with multiple notes beamed together in the upper voices. The lower voices (bass clef) provide a harmonic foundation with sustained notes and moving lines. The notation includes various musical symbols such as beams, slurs, and ties, indicating complex rhythmic and melodic relationships between the parts.

13

A

B

C

D

E

F

G

H

14

A

B

C

D

E

F

G

H

15

A

B

C

D

E

F

G

H

16

A

B

C

D

E

F

G

H

17

A

B

C

D

E

F

G

H

This musical score page, titled 'Reflection Part 3' and numbered 128, contains measures 17 through 20. It is written for eight parts, labeled A through H. The key signature is E-flat major, indicated by three flats (B-flat, E-flat, A-flat) in the key signature of each staff. Part A features a prominent melodic line with slurs and ties, while parts B through H provide harmonic support with various textures, including sustained chords and moving lines. The notation includes treble and bass staves for each part, with various musical symbols such as notes, rests, slurs, and ties.

18

A

B

C

D

E

F

G

H

The musical score for 'Reflection Part 3' begins at measure 18. It consists of eight parts, labeled A through H, arranged in four systems of two staves each. The key signature is three flats (B-flat, E-flat, A-flat). Part A has a treble and bass staff. Part B has a treble and bass staff. Part C has a treble and bass staff. Part D has a treble and bass staff. Part E has a treble and bass staff. Part F has a treble and bass staff. Part G has a treble and bass staff. Part H has a treble and bass staff. The notation includes various musical symbols such as notes, rests, beams, and slurs. The score is written in a standard musical notation style with a white background and black ink.

19

A

B

C

D

E

F

G

H

20

A

B

C

D

E

F

G

H

The musical score for 'Reflection Part 3' on page 20 is written for eight parts, labeled A through H. The key signature consists of four flats (B-flat major or D-flat minor), and the time signature is 2/4. The score is divided into two measures. Part A is a single bass line. Part B is a single bass line. Part C is a single bass line. Part D is a single bass line. Part E is a single bass line. Part F is a single bass line. Part G is a single bass line. Part H is a single bass line. The notation includes various musical symbols such as notes, rests, and bar lines.

22

A

B

C

D

E

F

G

H

The musical score is for a multi-instrument ensemble, likely a string quartet or similar. It consists of eight staves, each with a grand staff (treble and bass clef). The key signature is B-flat major (two flats). The time signature is 4/4. The score is divided into two measures. Staves A, B, and C are mostly empty, with some notes in the bass clef. Staves D, E, F, G, and H contain various musical notations, including eighth notes, quarter notes, and chords. The notation is complex, with many notes and rests. The score is for a multi-instrument ensemble.

24

A

B

C

D

E

F

G

H

The musical score is for 'Reflection Part 3' starting at measure 24. It consists of eight parts, labeled A through H. The key signature is four flats (B-flat major or D-flat minor). The time signature is not explicitly shown but appears to be 4/4 based on the note values. Parts A, B, C, D, E, and F are mostly silent, with whole rests in both the treble and bass staves. Part G has a melodic line in the bass staff, starting with a half note and followed by a series of eighth notes. Part H has a more complex accompaniment in the bass staff, featuring chords and moving lines. The score ends with a double bar line.