

# Considering musical structure in location-based experiences

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## ABSTRACT

Locative music experiences are often non-linear and as such the final structure of the music heard is guided by the movements of the user. We note an absence of principles regarding how composers should approach the structuring of such locative soundtracks. For instance, how does one compose for a non-linear soundtrack using linear, pre-composed placed sounds, where fixed musical time is placed into the indeterminate time of the user's experience? Furthermore, how does one create a soundtrack that is suitable for the location, but also functions as a coherent musical structure? We explore these questions by analyzing an existing 'placed sound' work from a traditional music theory perspective and in doing so reveal some structural principals from 'fixed' musical forms can also support the composition of contemporary locative music experiences.

## Keywords

Music theory; form; affordance; location; time; space.

## ACM Classification

H.5.5 [Information Interfaces and Presentation] Sound and Music Computing.

H.5.0 [Information Interfaces and Presentation] General

## 1. INTRODUCTION

Locative music has provided a rich theme of exploration for the NIME community, with composers and designers stretching out into new forms of creative and technical exploration that actively exploits the physical environment [14].

Scarce focus has been placed on probing how composers approach the creation of such musical experiences. Specifically, how does one compose for a non-linear, indeterminate experience using pre-composed 'placed sounds' and achieve a coherent structure, or form, for the music, in addition to dealing with the finer detail of the fixed musical time of pre-composed placed sounds set in the fluid time of a locative experience?

To further understand and tackle these questions we attempt to connect some traditional music theory of absolute (fixed) music to location based (fluid) music experiences, to reveal some relationships between the two that may support the composition of such locative experiences. By music theory, we refer primarily to musical form that underpins the western tonal tradition of music composition.

We retrospectively analyze an existing placed sound work to reveal how its musical structure draws on traditional musical forms, which enable the music to interlace gracefully into the physical structure of the location and maintain a coherent

musical structure. We also expose some techniques applied in making fixed musical time more malleable to the indeterminate time of a user experience. Thus, this work is aimed at *experienced composers*' working in *placed sound experiences* that employ *pre-composed* musical elements *triggered via GPS*, on contemporary smart phones. The novelty of this work is found in the interlacing of traditional music theory into a contemporary location-based musical experiences.

## 2. RELATED WORK

We now present a brief overview of related work on location based experiences.

Locative Media experiences have been embraced by a wide range of artists and designers seeking to explore the potential for interactive experiences that connect audiences with their environments in new ways. Location and mobility has been utilized as both a producer of content or a stage for content delivery [14]. Behrendt [2] classifies four general approaches to mobile sound art: '*sound platforms*' [1], '*sonifying mobility*' [4,6] and '*musical instruments*' [12] and '*placed sounds*' [3,16]. Our interest in this paper is with 'placed sound' experiences.

*Placed sound* experiences [2] typically employ pre-composed or pre-curated sounds that are 'fixed' to specific locales. Thus, when a listener's trajectory intersects with the proximity area that covers a *placed sound*, playback is triggered. GPS is the common technical solution for tracking a user's location and initiating playback of the placed sounds. Whilst, it is acknowledged that GPS can be crude, error prone and thus unreliable, its ubiquity on smart phones and global coverage make it a useful medium to manage such experiences. Accordingly, they are typically non-linear, as their arrangement depends primarily on the route and walking pace of the user.

*Placed sound* experiences come in many forms, utilizing a range of audio such as voice, ambient sound and music. Some overlay narrative or historical content descriptive of the location [2,5] as found in some soundwalks and tour guides, while others use a specific location as a canvas for interacting with bespoke music albums [17], such as those produced by BlueBrain [16]. Here, composers use a location as a template upon which they map their music to extend the modality of the listening experience. Thus these locative albums only reveal their content when the locations are visited and explored.

## 3. ANALYSIS METHOD

This work analyses the design and composition of an existing GPS driven locative soundtrack for Yorkshire Sculpture Park (UK), a large cultural visiting experience, as charted in [7,8]. We urge the reader to familiarise themselves with this work to best understand the analysis presented here. We consider the soundtrack from the perspective of *musical form* and the management of *musical time*, which have been deliberately chosen as they represent some of the key elements typically found in the compositional process in absolute music.

### 3.1 Musical form

*Musical form* – from a music theory perspective – concerns the overarching structure of a piece of music, how its constituent sections, melodies, phrases and motifs interact and interrelate. During the classical period established ‘forms’ – templates upon which compositions were structured – functioned as the back bone of musical structure and these ‘traditional’ approaches still hold some resonance today, being regularly taught in contemporary compositional practice. Traditional musical forms are numerous and are often strongly associated with particular styles, but the majority can be categorized as either *sectional forms* or *developmental forms* [13]. *Sectional forms* concern the arrangement of blocks, or sections of music that combine to construct a whole, such as *Ternary Form* (A-B-A) or *Chain Form* (A-B-C-D) [13]. Whereas, *developmental forms* are more organic in their nature, motifs or themes are treated as building blocks to create new musical ideas and sections [13]. Some, such as Toch [15] argue that these established forms are restrictive and ‘form in music’ is better viewed as moments of contrast.

### 3.2 Musical time and space

Morgan [10] argues that music functions in its own space, as simultaneous musical events (e.g. melodic lines; counter-melodies; motifs), a “*space of relationships*”. Musical time has also been viewed as the principal factor in establishing musical form, where music is viewed as a temporal contour punctuated by moments of arrival [11] (i.e. moments of *contrast* [15]) and that the succession of these moments of arrival are what organize the formal structure of a composition.

Music can be measured by seconds, minutes and hours, but this would tell us little about the nature of it. Musical time, it would seem, is measured by factors such as pulse, tempo, metre and the structure of motifs and phrases. Thus, in non-linear, indeterminate *placed sound* experiences *musical time* and the time spent located in, and engaging in a physical location (*experience time*) are not temporarily aligned. In light of this, it is unclear how one manages *musical time* in *placed sounds* composition to present a coherent unfolding of the music.

## 4. MUSICAL ANALYSIS

### 4.1 Topographic musical forms

In light of the concepts presented above we retrospectively review the composition and authoring of the soundtrack, with a particular focus on the *musical landscapes* and *musical trajectories* compositional approaches developed and utilized by Hazzard *et al.* [7, 8].

#### 4.1.1 Musical landscapes

The soundtrack was structured around a set of regions; each one afforded a different musical treatment. The notion of distinct regions was largely in reply to the park’s physical structure, to thus accompany different physical spaces and exhibits with diverse musical ‘scenes’ as illustrated in Figure 1.

This global structure of adjoined musical regions would appear to characterize sectional forms and on first observation appears indicative of *chain form* (A-B-C-D *etc*) [13] a series of disparate musical sections. Hazzard *et al.* [7] note that each region was made musically distinct by a unique combination of orchestration, thematic material and key centres, with the exception of *Region A*, which reoccurs in four different areas of park (see fig. 1), *Region A* was considered a ‘holding’ region [7], as they were not populated with exhibits, but nonetheless required journeying through in order to reach other areas of the park. The same music was presented in each occurrence of

*Region A*, to convey to the listener that they were located in an area not containing exhibits, but were nonetheless still engaged within the global soundtrack experience. With this in mind, the soundtrack experience can be partitioned into two functions: first, those *passive regions* without exhibits and second, those *active regions*, which contained exhibits.

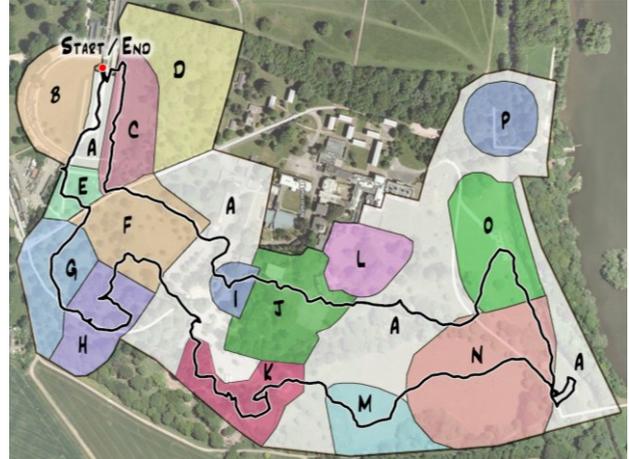


Figure 1: Structure of the soundtracks’ regions

Figure 1 also illustrates a sample visitor’s walking route, which reveals repeated entry in and out of these *passive regions* that intermittently punctuate periods spent in the *active regions*. These qualities encapsulate another sectional form termed *Rondo* [13]: the first section (A), the *refrain*, is stated at the outset and repeats on alternate instances, each time intersected by a new, contrasting *episode* composed in a different key centre to the tonic key of the *refrain* (i.e. A-B-A-C-A-D-A *etc*). In this soundtrack we can view the *passive Region A* as the *refrain* (E Minor) and as we observed the other *active regions* (*episodes*) were composed with contrasting orchestrations in different key centres. Furthermore, the soundtrack’s intro and outro sections were variants of *Region A*, thus our *refrain* represents the first and final sections presented by the soundtrack, in keeping with a *Rondo* structure. However, as illustrated in the visitor’s walking route (fig. 1) the indeterminate nature of the soundtrack experience does not result in a regular alternating *refrain / episode* structure (the primary shape of *Rondo Form*). Nonetheless, if we consider the structure of the music from the perspective of the visitor experience – which can be viewed as time spent in either *active* regions engaging with exhibits or in *passive* regions not engaging with exhibits – then a regular alternating *Rondo form* is revealed. Figure 2 illustrates the first half of the visitor’s route illustrated in Figure 1.



Figure 2: Rondo Form structure

#### 4.1.2 Musical trajectories

Now we consider formal structure at a lower level, within the regions themselves. Hazzard *et al.* termed their compositional approach within regions ‘musical trajectories’; music that accompanies visitor interaction in and out of engagement with exhibits [7]. The example of *Region O* (fig. 1) reveals the formal structure of a *musical trajectory*. Here a large sculpture is set in the centre of the region surrounded by 4 trigger zones which trigger the musical adaptations that form the *approach, arrival, engagement and withdrawal* phases of the *musical*

trajectory [7, 8]. On *approach*, a melody presented by strings ascends upon entry into each successive *approach* zone, reaching a climax at the *arrival* zone. The music then modulates key and the dynamic level reduces for the *engagement* phase. When a visitor *withdraws* from the sculpture the underlying music of the approach is represented, but without the rising melody, but rather maintaining a lower dynamic level. *Musical trajectories* are essentially described by *Ternary form* (A–B–A<sub>1</sub>). *Approach* denotes A; *arrival* and *engage* fold neatly into B; and *withdraw* a variation of A<sub>1</sub>.

*Region K* (fig. 1) is an area characterized by a weaving walkway with exhibits placed at various points along its path. Although a single physical area, Hazzard *et al.* sub-divided its length into a set of smaller sub-regions to incorporate some musical variation along its duration [7]. Looking at the music in more depth reveals that this set of three regions are constructed around a *Chaconne*, a baroque dance form [13]. *Region K* follows the typical characteristics of a *Chaconne*: triple metre (3/4), minor tonality, an ostinato bass part upon which melodic lines are presented and harmonic shifts to distinguish between the sections (i.e. Emi – Bmi – F#mi).

## 4.2 Managing Musical Time

In this section we shift our focus onto how this soundtrack accounted for the uncertain duration that a user may spend listening to any particular placed sound. Typically in music, a section or phrase is fully realized before transitioning to the next and they are commonly repeated an even number of times (e.g. 4, 8, 16) to provide balance and familiarity for the listener. Through repeated exposure humans anticipate these types of musical structures [9]. However, it is problematic to regulate even phrase structures in non-linear experiences. The following considers some methods utilized by Hazzard *et al.* [7] to reduce the impact of irregular presentation of musical time.

### 4.2.1 Working with melodies and phrases

Analyzing the melodic themes within the soundtrack revealed a tendency for short phrase lengths and an attempt to reduce the prominence of melody in the overall orchestration:

- The music contained within regions was frequently constructed around 1, 2 or 4 bar phrases (fig. 3 & 4). This enabled the shape of the music to unfold quickly and then repeat, which in turn promoted prompt familiarisation even if heard for transitory periods. Thus, if a visitor transitions rapidly from one *region* into the next, the music will have had time to establish itself prior to the transition. As is typical of melodic construction, iterations on the melodic shape were presented on repeats, which integrated some variation in the event of prolonged exposure.
- Melodies were predominately formed around sustaining legato themes located in lower pitch ranges, constructed around simple contours using medium to long note values (fig. 3). By placing melodies in the middle of the orchestration their prominence in the musical texture is reduced. Furthermore, their flowing nature lessened any ‘percussive’ protrusion.

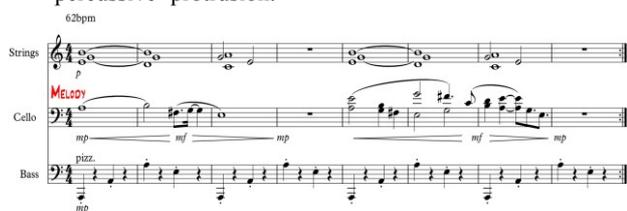


Figure 3: A fragment from *Episode C*

Some regions were composed with a ‘fragmented’ quasi-improvised approach to further diminish the perception of a regimented phrase structure. *Episode L*, employed a very simple 1 bar motif and varied it upon every repeat (fig. 4). The audio file used in this region consisted of 24 variants of this motif along with 4 versions at different densities of texture (for stages of the *approach* phase) to support extended listening with little direct repetition. Moreover, they were performed with abundant rubato (flexible time), which further heightened the notion of an improvised performance. This aided transitions between adjacent regions as the reduction of emphasis on tightly structured phrases [9] in turn lowered the perception of a break in the flow of the music upon a transition in or out of it.



Figure 4: A fragment from *Episode L*

## 5. DISCUSSION

We now consider how our analysis – in the context of musical form and musical time – can shed light on key relationships between musical theory and locative musical experiences.

### 5.1 Musical form

#### 5.1.1 Transitions, arrivals and sections

Whilst this soundtrack fundamentally corresponds with Ratner’s [11] view of musical form – sections built around points of arrival – in addition to Toch’s [15] – form in music is better understood as moments of contrast, rather than fixed sectional structures, it has also embraced a number of sectional forms that have supported both the composition of the music and also the functional structure of the locative experience.

Our analysis has revealed two levels of formal structure at play: the high-level regional structure of *passive* and *active* regions configured around the physical space, which follows the conventions of *Rondo form* [13]; and within those *active regions* we have also noted *sectional forms* shaping visitors *musical trajectories* in, through and out of engagement with sculptures. Thus, we distinguish form within form (fig. 5).

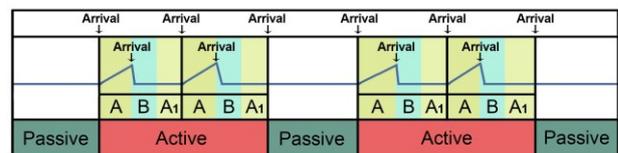


Figure 5: Form within form

The application of traditional musical forms in this soundtrack has then guided compositional decisions, such as the composer’s choice of key centres, metre and methods employed for the composition and variation of thematic material.

### 5.2 Musical time

We now consider the analysis of *musical time* in the YSP soundtrack. The approach taken by Hazzard *et al.* [7, 8] was an attempt to compensate for the indeterminacy of *experience time* by composing music that both reduced the prominence of melodies and also the utilization of concise phrases, motifs and

motif variations to allow the music to establish itself promptly. The methods applied focused inevitably on reduction and compensation and appeared effective to a degree. However, we must emphasize that these techniques were developed and applied in tandem with the soundtrack's musical style [8] and we ought to note the difficulty of removing style from composition process. This in turn raises questions over how effectively these approaches may transfer to other settings and styles of music.

### 5.3 Summary notes on application

We now summarize the techniques revealed here as a set of guidelines for structuring the composition of locative music experiences. We do not promote these guidelines as prescriptive, but rather a set of creative motivators for the composer, which integrate some traditional (fixed) music practices into the realm of (fluid) locative soundtracks.

**Sectional forms:** can be utilized to construct a musical structure around the high-level locative experience such as the locations physical structure or the nature of activity taking place within the location (e.g. mobile games = in or out of gameplay; exhibitions = engagement with exhibits or not; urban walks = in a free-roaming area vs negotiating traffic). Furthermore, sectional forms can be placed within a high-level structure to guide a finer granularity of musical structure. In addition to constructing contrasting episodes they can guide a composer's choice of key, metre, tempo and thematic or rhythmic elements.

This soundtrack used a retrospective approach in applying musical form, in that appropriate musical forms were sought to integrate gracefully into the physical structure of the park. Alternatively, their application could employ a formative approach, where the structure of the music takes a central role in defining the 'virtual' structure of the location. This approach may be appropriate for a mobile game or a locative experience where the music operates as the primary modality.

We have seen that musical forms will inevitably unfold unevenly in regards their *musical time*, which is the nature of indeterminate locative experiences using a *placed sounds* approach. Thus, we would suggest that their function is primarily a broad brush design tool for composers rather than a method that will result in a perfectly balanced musical form. However, some techniques, such as those below may assist in reducing the irregularity of indeterminate *musical time*.

**Managing musical time within experience time:** multiple variants of short phrase length melodic themes can allow for controlled presentation of musical material, which can be quickly digested by the listener. Utilization of rubato or an improvised 'feel' can reduce listener expectation of a rigid phrase structure and thus smooth irregular transitions between adjacent placed sounds. Furthermore, by moderating the prominence of melodic themes by means of their orchestration (placement in lower pitch ranges and the reduction on strong rhythmic content) can also diminish the impact of irregular transitions between sets of placed sounds.

## 6. CONCLUSION

This paper has highlighted some techniques for structuring the composition of locative *placed sound* experiences by drawing on some fundamentals of music theory, specifically musical form. Through a musical analysis of an existing 'placed sound' experience we have shown how traditional (fixed) musical forms can integrate into and support the composition of an expansive (fluid) locative musical experience. Methods to balance the pre-determined nature of musical time into the indeterminate nature of experience time were also investigated.

We recognize that this work is based on one example and thus represents the beginnings of future research that needs to explore a range of methods in a variety of musical settings.

## 7. ACKNOWLEDGMENTS

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## 8. REFERENCES

- [1] Bassoli, A., Cullinan, C., Moore, J., and Agamanolis, S. TunA: A mobile music experience to foster local interactions. *Proceedings UbiComp*, Citeseer (2003).
- [2] Behrendt, F. The sound of locative media. *Convergence: The International Journal of Research into New Media Technologies* 18, 3 (2012), 283–295.
- [3] Chamberlain, A., Oppermann, L., Flintham, M., et al. Locating experience: touring a pervasive performance. *Personal and Ubiquitous Computing* 15, 7 (2011), 717–730.
- [4] Fencott, R. and Bryan-Kinns, N. Sensory threads: Sonifying imperceptible phenomena in the wild. *Proceedings of the 6th Sound and Music Computing Conference*, (2009).
- [5] Gaye, L., Holmquist, L.E., Behrendt, F., and Tanaka, A. Mobile music technology: Report on an emerging community. *Proceedings of the 2006 conference on New interfaces for musical expression*, IRCAM—Centre Pompidou (2006), 22–25.
- [6] Gaye, L., Mazé, R., and Holmquist, L.E. Sonic city: the urban environment as a musical interface. *Proceedings of the 2003 conference on New interfaces for musical expression*, National University of Singapore (2003), 109–115.
- [7] Hazzard, A., Benford, S., and Burnett, G. You'll Never Walk Alone: Designing a location-based soundtrack. *Proceedings of the 2014 Conference on New Interfaces for Musical Expression*, (2014), 4.
- [8] Hazzard, A., Benford, S., and Burnett, G. Sculpting a Mobile Musical Soundtrack. *Proceedings of the 33rd annual ACM conference on Human factors in computing systems*, ACM (2015).
- [9] Meyer, L.B. *Emotion and meaning in music*. University of Chicago Press, 2008.
- [10] Morgan, R.P. Musical time/Musical space. *Critical inquiry*, (1980), 527–538.
- [11] Ratner, L.G. *The musical experience: Sound, movement, and arrival*. Stanford Alumni Association, 1983.
- [12] Reality Jockey. RjDj. *The sonic experiences of the 21st century!*. <http://rjdj.me/>.
- [13] Stein, L. *Structure & style: the study and analysis of musical forms*. Summy-Birchard Music, 1979.
- [14] Tanaka, A. Visceral Mobile Music Systems. In *Transdisciplinary Digital Art. Sound, Vision and the New Screen*. Springer, 2008, 155–170.
- [15] Toch, E. *The Shaping Forces in Music* (New York: Criterion Music Corp., 1958). *Edward T. Cone, Musical Form and Musical Performance*, , 11–31.
- [16] BLUEBRAIN. <http://bluebrainmusic.blogspot.co.uk>.
- [17] Jorge Drexler | Small World Music. <http://smallworldmusic.com/artists/jorge-drexler/>.

