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### Original Citation

Clarke, J.M. (2009) Extending Interactive Aural Analysis: Acousmatic Music. In: Electroacoustic Music Studies Network EMS 09: Heritage and Future, 22nd - 25th June 2009, Buenos Aires, Argentina. (Unpublished)

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# Extending Interactive Aural Analysis: Acousmatic Music

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## 1. Background

At the EMS conference in 2007 in Leicester I described the approach I had taken to making an analysis of Jonathan Harvey's work *Mortuos Plango, Vivos Voco* (1980). The analysis had appeared in the book *Analytical Methods of Electroacoustic Music* (Clarke 2006). In particular I explained my concern about relying exclusively on the printed page in analyses of electroacoustic music: be that in the form of text, diagrams or printed sonograms etc. Since such music exists primarily, often entirely, in an aural form, and given the limitations of any type of graphical transcription of sound, I was keen to enhance the *static and visual* printed component of my analysis with the addition of an *aural and interactive* component (by means of software). Why do we so often turn exclusively to text and visual representations when what we are really concerned about is sound? Unlike acoustic music, where a score can be read by a trained musician and can provide a reasonable indication of the sound, and where even words and terms such as 'perfect cadence' can designate precise harmonic content, in electroacoustic music words and graphics can rarely give a reliable account of how the music really *sounds*. If the analyst is to engage the reader with the sound of the music a different approach is needed: one that incorporates the aural, preferably interactively. Text and graphics may well have a role in analytical presentation, but only when closely allied to interaction with the sound itself. Developments in recent years in software and hardware now make this a possibility (Clarke 2005).

At EMS 2007 I demonstrated my new interactive aural approach as applied to one particular work, *Mortuos Plango, Vivos Voco*. Here there is only time to outline briefly the main features of that analysis as a basis for demonstrating more current developments growing from them. The two key ideas are: (1) that the analysis of a work should involve a strong aural component, the reader being encouraged to engage with the musical world of the piece in greater depth, *as sound* and (2) that the analysis should not only present the analyst's views of the work but should also encourage the listener to explore the sounds and structure interactively for themselves.

At its most basic the software (Clarke 2006/2008), written in Max/MSP, acts as a sophisticated CD player, playing precise extracts at the click of a button, making it easier to reference particular moments in the work and quickly to compare different passages from disparate sections of the work. In the text numbered 'Sound Locations' refer to cues in the software so that the text can immediately be connected to the aural impact of what is being discussed.

A more elaborate stage was the construction of an aural paradigmatic chart. Buttons on the screen laid out in the manner of a traditional paradigmatic chart, but instead of reading score extracts, the reader clicks the buttons to play aural extracts. This is useful for gaining a sense of the structure and shape of the work and for tracing the evolution of particular elements (paradigms) through the course of the piece. Aural reductive sketches are also used, distilling key structural elements, but again aurally rather than visually.

More complex still is the provision of Interactive Exercises. These emulate various techniques used in the composition of the work. They permit the user to develop an understanding of the technical processes involved and their creative significance by experimenting with them. For example, one particularly significant compositional technique in *Mortuos Plango* is the use of very precisely constructed glissandi which play a crucial role in the timbral and structural shaping of the work. Figure 1 is a screen shot from this Interactive Exercise. The software enables the user to recreate these glissandi and play with the technique changing the parameters, deepening their understanding of the process, its potential and how it sounds.

## 2. The current project

Building on that analysis, I am now working at extending the interactive aural approach to a wider repertoire, not simply adding new analyses, but developing and adapting the method and the software tools strategically for different aesthetic and technical approaches to composition. Presently I am working on extending interactive aural analysis in two different and complementary directions:

- 1) Acousmatic Music
- 2) Mixed media works.

For the second of these I am analysing Pierre Boulez' *Anthèmes 2* for violin and live electronics. This raises issues of how to tackle score-based material combined with processes that transform the acoustic violin sound in real time. But it

is the first of the new directions, acousmatic music, that I am going to focus on here, and for this I am analysing a classic of the acousmatic repertoire: *Wind Chimes* (1987) by Denis Smalley.

So what will be different about this analysis? What needs to be done to make the interactive aural approach suitable for an acousmatic work like *Wind Chimes*?

Firstly, five years on from starting my analysis of *Mortuos Plango*, both my own thinking and the technical possibilities have advanced considerably and many of the techniques I used previously can be refined or extended in significant

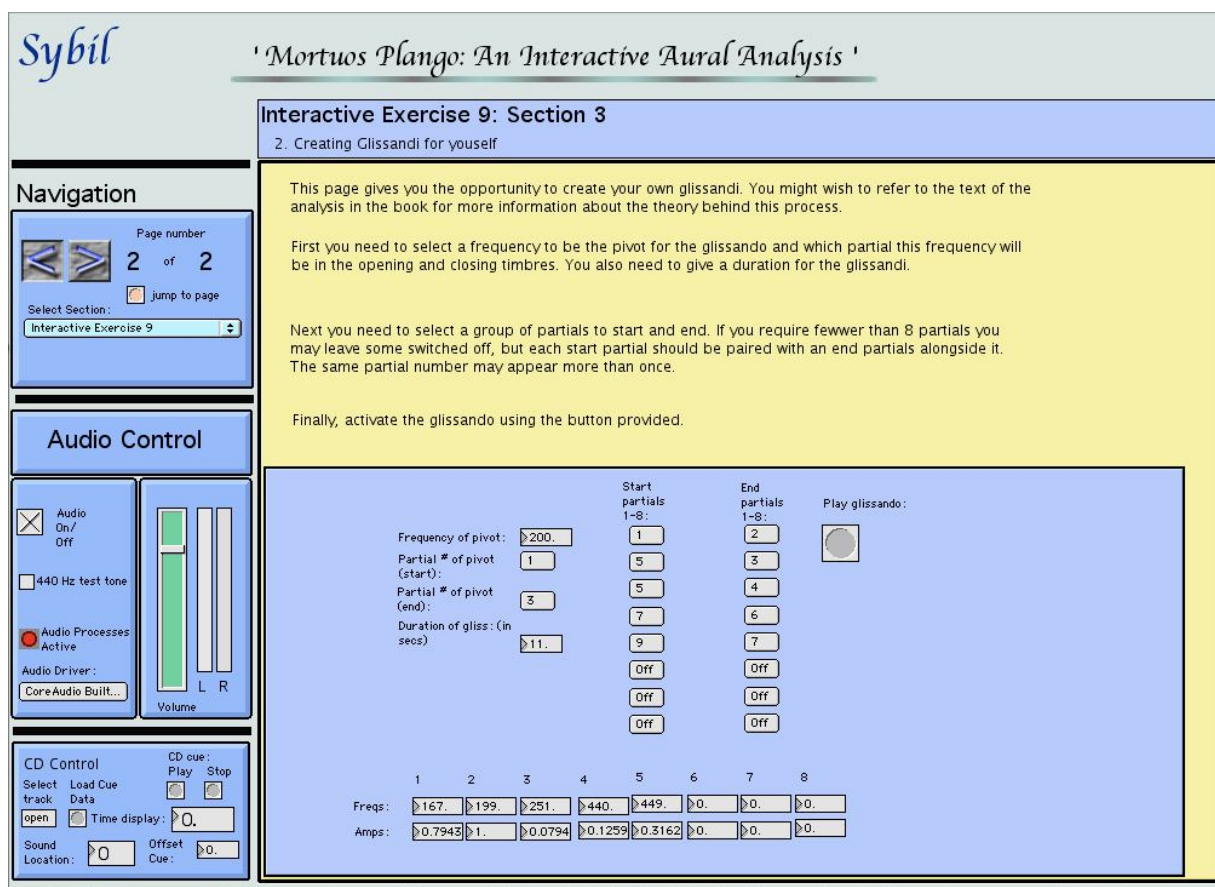


Figure1: An interactive exercise from the analysis of *Mortuos Plango, Vivos Voco*

ways. For example, Jitter is used in the software I am going to demonstrate shortly, extending the capabilities of Max/MSP significantly.

In terms of the works themselves, whilst there are similarities in some respects between *Mortuos Plango* and *Wind Chimes* there are also many differences, technically and aesthetically, and also simply in terms of practicalities, and these differences require some change of emphasis in the analytical software. Whilst both works have become classic reference points in the development of electroacoustic music and whilst both are notable for the sheer beauty of their sound worlds, the composers arrived at these achievements in very different ways.

Jonathan Harvey took a spectralist approach to his sound materials. He analysed the spectrum of the bell and the voice and used the data from these analyses, especially the bell, to structure every aspect of the work. Everything was precisely planned and documented (even if there was room for intuitive revision later), and although the technology and software he used is now obsolete it was relatively clear how these processes could be recreated. Technically and analytically there was a very precise and well-documented basis from which to begin. The composer's charts and data provided enough information to describe virtually every aspect of the piece, almost algebraically.

Denis Smalley (1986) was first publishing his theories of *spectromorphology* at around the time of writing *Wind Chimes* in 1987. But although he was thinking deeply about issues of shape and structure, his approach to his materials was intuitive rather than analytical, and his approach to the technology often one of experimentation, albeit very carefully considered and documented. He carefully noted the settings for each process and the source materials used, and frequently he added comments on the usefulness of the results on cards used to index the materials. However, few of the source sounds are still in existence and with those that do it is often not clear what their relationship is to the data cards. Smalley used the software that was then in Studio 123 at GRM to generate most of the transformations in the work: software that is now obsolete (although a partial emulation exists and in some respects the software is similar to GRM tools today). The work was not pre-planned, it took shape as the composer worked with the materials. Unlike the Harvey work, it was not crucial to his concept of the work to control exactly what each process did to the sound in a theoretical sense and with the original software no longer available it can be hard to reconstruct the way the work was put together. Even the composer himself is unsure of many of the precise details.

With the analysis of *Wind Chimes*, therefore, more emphasis on a top-down approach is required, and indeed is perhaps more appropriate to the concept of the work. Rather than knowing the structures and parameters in advance and being able to use this information as a starting point for interpreting the work, with *Wind Chimes* it is necessary to a large extent to put the finished work under the microscope and try to tease out of it the essential features. Much of the time the analyst must mirror the composer's approach in using an experimental approach. If anything, an interactive aural method is even more important in this context.

So for this analysis further development of the technique of paradigmatic and other structural charts presented aurally is especially important. Related to this, finding ways of to assist both the analyst and the reader to explore the work interactively and aurally becomes very significant as a means of discovering appropriate segmentation. Whereas the paradigmatic chart for *Mortuos Plango* like traditional acoustic analyses segmented the work only in terms of time, for this analysis I am exploring the possibility of two dimensional segmentation: in time and frequency. And although at EMS in 2007 I criticised the overuse of sonograms printed on the page (and I would stand by this), I am now developing ways of using sonograms interactively and aurally in real time, in part as an aid to two-dimensional segmentation. This makes all the difference: the visual supplements the aural, and the aural meaning of the visual sonogram can be interrogated interactively. Processing of FFT data, facilitated by Jitter and developing ideas of Jean-François Charles (2008) from a different context, makes it possible to interact with the sound in real-time in interesting new ways. Of course, excellent pre-packaged software for sonograms already exists (for example, IRCAM's *AudioSculpt* or GRM's *Acousmographie*) but using Max/MSP means the software can be incorporated into the analysis software package and freely adapted as necessary for the context. Although emulating the precise techniques used is more difficult with *Wind Chimes*, I am developing a way of enabling the user to explore the types of process used in creating this work and to trace the genealogy of a set of sounds from source material to complex texture.

The finished analysis will comprise written text together with software which will not only present my own interpretation of specific features of the work but also provide tools to enable the user to continue their own investigation of the music aurally and interactively.

### 3. Examples from the analysis software

The second half of the conference presentation comprised a live demonstration of the software under development for the analysis of *Wind Chimes*. Here a number of examples from the software are given in the form of screenshots with explanatory commentaries:

#### 3.1 An aural taxonomy

A key part of the analysis is the segmentation of the work into its significant components. Figure 2 shows an extract from the resulting taxonomy in provisional form in the software. The segmentation of the work is along the lines of Smalley's theories of spectromorphology (Smalley 1986, 1997). Since this is an Interactive Aural Analysis it is possible in the software to click on the list on the right hand side of the chart and play sound examples from the work illustrating each of the different categories of sound.

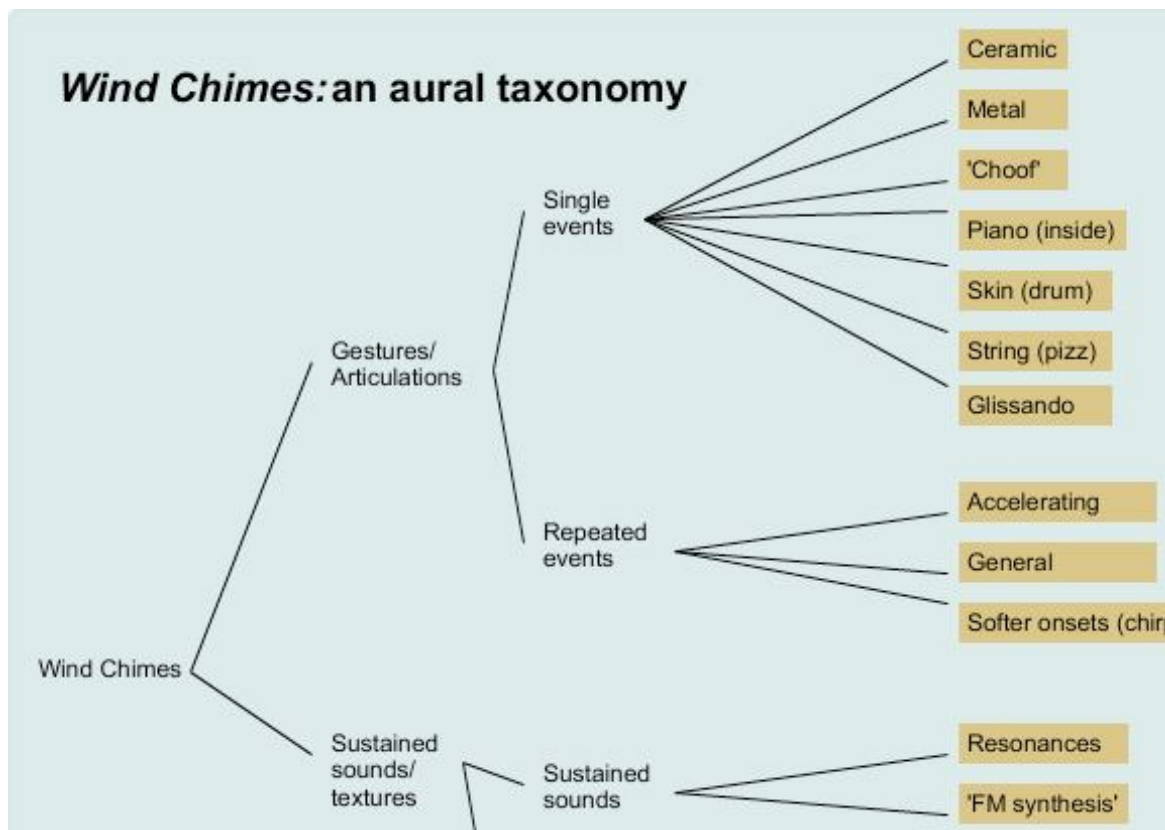


Figure 2: Extract from an aural taxonomy of *Wind Chimes*

### 3.2 A two dimensional aural paradigmatic analysis

This segmentation provides the basis for an interactive aural paradigmatic chart. A screenshot of a portion of the display for this software under development is shown in Figure 3. Down the right-hand side labels indicate the different paradigms (corresponding to the taxonomy discussed above). For practical reasons, unlike most traditional paradigmatic charts time runs horizontally, left to right, and rather than fragments of score buttons represent the segments and clicking them plays the appropriate sound extract. Above this buttons are provided to enable the reader to contextualise segments by playing whole sections or subsections.



Figure 3: Extract from the interactive aural paradigmatic chart of *Wind Chimes*

At the top a waveform display highlights the portion of the work corresponding to the segment selected. On the right at the top data is given about the current time in playing, the start and end times of the segment and the upper and lower frequency boundaries. This is significant because unlike traditional paradigmatic charts, which comprise events segmented only in one dimension (time), segmentation here is in two dimensions, time and frequency. This is important because unlike most music chosen for paradigmatic analysis, *Wind Chimes* often has many different overlapping layers of sound at once. Although the frequency division is never perfect (because partials from different sounds normally overlap) such segmentation does help highlight different elements of the music. There are different options for playing each button. Clicking plays the full frequency range for that time segment. Alt-clicking plays only sounds within the specified frequency range, whilst Ctrl-Alt-clicking plays everything apart from the specified frequency range.

### 3.3 An interactive aural sonogram

Figure 4 shows a screen shot from the 'Sonogram Explorer' under development, an interactive aural sonogram. Unlike printed sonograms which only rarely show aurally meaningful information, this sonogram in software can be heard. Furthermore it is possible to interact with it in various ways. For example you can play back the sound at different speeds, slowing down complex passages or rapidly evolving sonorities to hear their shape more clearly. There are of course some limitations and the reader always needs to keep this in mind and refer findings back to the original sound. It is also possible to drag a cursor through the sonogram, 'scrubbing' the sound. The frequency range of the cursor is variable so that particular parts of the sonogram can be picked out (this can be seen towards the bottom right hand corner of the sonogram in Figure 4). It is also possible to draw shapes over the sonogram and hear just those portions. All this can be done in real time. Technically this is programmed using pfft~ and Jitter in MSP.

## 4. Future work

The Interactive Aural Analysis of *Wind Chimes* is due to be published in 2010 by the Groupe de Recherches Musicales (GRM) in Paris as a chapter in an edition of their *Portraits Polychromes* series dedicated to Denis Smalley's music with accompanying software on the internet. The analysis of Boulez' *Anthèmes 2* is to be published by IRCAM. It is hoped that these analyses will demonstrate the potential of this approach to analysis across a wider range of music. It is then intended to continue to broaden the repertoire covered and hoped that others might take up this approach. Potentially the interactive aural approach can be helpful in broadening the understanding of the genre not only amongst specialists, professionals and students, composers and musicologists, but (in adapted form) might also help introduce the general public to this genre of music. Such analyses could be presented at different levels for different audiences. It is intended that the source code and tools developed in this process be made available publicly so that others can use and develop



them. Technology keeps developing and new possibilities arise. Indeed working on the current analyses new possibilities have emerged not all of which can be fulfilled in the current time-scale. Another aspect of the continuing work will therefore be the exploration of new technical possibilities to enhance the interactive aural approach to the analysis of electroacoustic music.

I would like to thank Sam Freeman, a postgraduate at Huddersfield for help in developing parts of the software, Yann Geslin of GRM for advice on the workings of Studio 123 software, Evelyn Gayou also of GRM for her enthusiasm for this work and Denis Smalley for his help and encouragement throughout the project. Funding from the Arts and Humanities Research Council (Research Leave Scheme) has been awarded since the conference and is helping provide me with the time to complete this project.

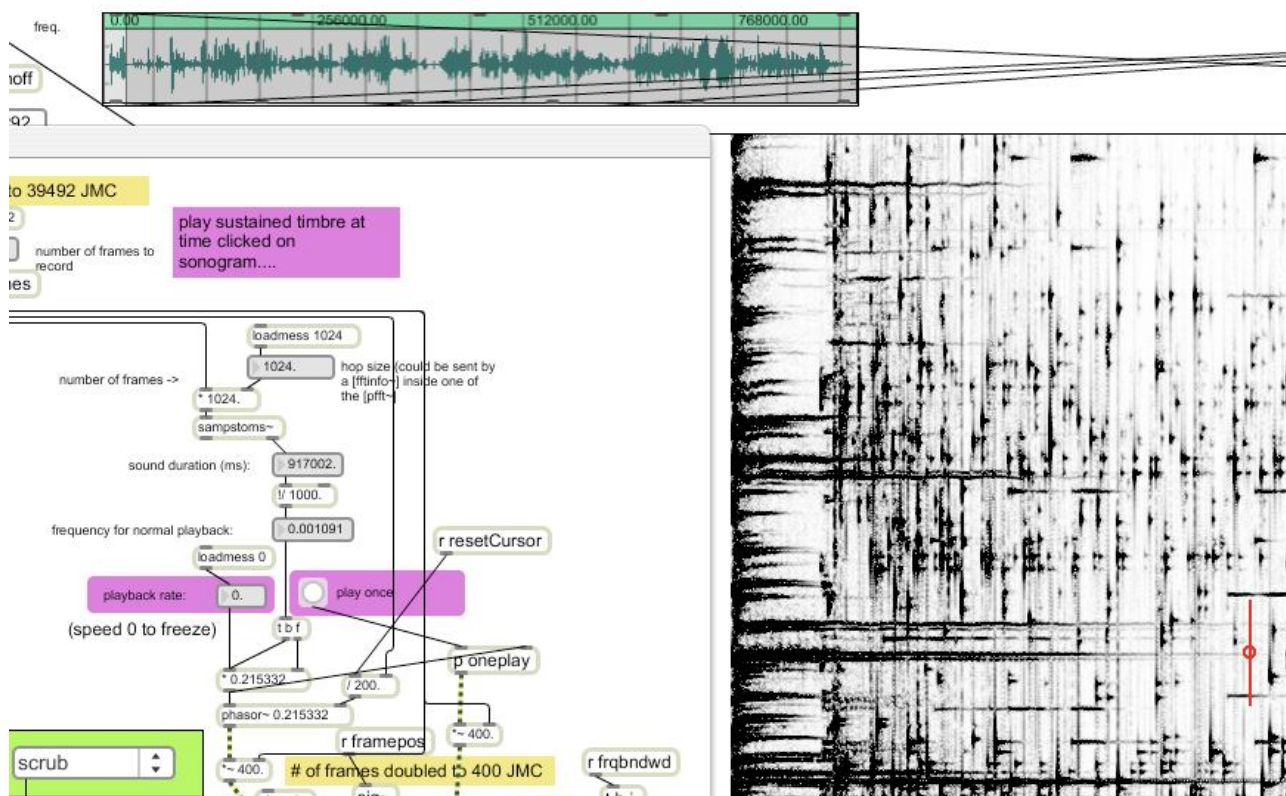


Figure 4: Screenshots from an interactive aural sonogram (under development)

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