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M-Level Project

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Paper 1: Recording 'Circles' by Neil Campbell

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<u>Contents</u>

Recording 'Circles' by Neil Campbell

Abstract

Although the title suggests otherwise, one may be forgiven for assuming that this paper focuses solely on the techniques and practices used to record, edit and mix the 3 movements that constitute contemporary composer Neil Campbell's latest body of work, 'Circles'.[1]
Though the above is discussed in detail and highlights the role and function of the specific multi microphone array techniques selected to be used for the recording. The paper also investigates, tests and examines[2] the practical application of a variety of alternative multiple microphone arrays throughout the pre-production stage in typically unorthodox surroundings, [3] critically assessing whether such techniques can be applied to more commonplace record production.

The techniques utilised are specifically designed for capturing a 360-degree image of a said sound source with the intent to reproduce via a 5-channel playback system. Though the research and tests undertaken within this body of work focus solely on the 2d, horizontal planar with regards to capturing and reproducing audio, binaural encoding to headphones is briefly examined as a way in which surround projects can be accessed via the average listener on a standard pair of stereo headphones.

Ultimately through research and critical analysis[4], the most suitable techniques are chosen in an attempt to meet the vision laid out via the composer.[5]

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[1] A suite of music composed specifically for multi-channel sound reproduction.
[2] From a subjective point of view.
[3] Arguably the majority of multi microphone arrays utilised to capture spatial audio and more specifically ambience for reproduction via either stereo or multi channel systems are associated with larger ensembles in larger reverberant spaces, like that of the concert hall.

[4] Mainly subjective.
[5] The recording of 'Circles' is a co-production between Neil Campbell and Mark Brocklesby.

Introduction

I remember the first time I started working at Binarycell Studios in Liverpool and was introduced to mixing in surround. The control room had been designed and shaped as an octagon, and the Genelec 8040 satellites were flush mounted and housed into five individual blocks, all spaced out and measured perfectly to meet the ITU-775 specification.
The control room was not anechoic, but acoustically it was far more deadened than any other control room I had graced previously and the frequency dispersion from the speakers after room calibration provided what I now consider in hindsight to be an amazing sweet spot for mixing.

However, regardless of the ergonomics and genuinely great listening environment[6] it was amazingly freeing to place pre-recorded sounds within the 360-degree 2d horizontal planar and although it is hard to measure highly subjective terms such as 'envelopment' and 'immersion', I can honestly say that it was the closest I ever felt to being 'in' the music.[7]

In essence it was truly inspiring, and even as it became evident that 5.1 was a far from perfect reproduction system I was starting to think of how it could be utilised in a creative manner and more specifically how it could be incorporated into my approach to record production as a whole.

Contextually throughout my career as a freelance recordist, I have found myself gaining valuable experience whilst working on a variety of musical styles performed by orchestras, ensembles, bands and soloists.

Although these recordings have taken place within different studios and on location in some interesting ambient environments and microphones have obviously played an integral part in this process, very little had been approached with surround sound in mind.

In reality the majority of my experience with multi channel audio up until a few years back, was to up mix stereo recordings to surround by mirroring into the rear speakers or simply placing mono signals into the specific speakers via the surround panners in Nuendo.
It was only whilst working on the feature film 'Powder' back in 2011 that I put together my first array. The array was loosely based on the 'Ideal cardioid arrangement' or 'INA-5'. [8]

The array I assembled at the time was based on measurements provided in a paper on multi microphone array design by Williams and Le Du (2000).[9]

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[6] The room was fairly fatiguing on the ears due to the absorption coefficient.
[7] Other than performing on stage.
[8] A diagram highlighting the configuration of the INA-5 can be seen on pg.38, in figure 2, of the research paper. This second paper is entitled 'Personal Testing, Practical Research & Development (a)'

[9] There has been no specific name attached to the array designs suggested by Williams and Le Du, though there are similar commercial systems working around the principles they propose for array design. Some people have referred to such designs as 'TSRS' or 'True Space Recording system'. For the sake of this paper I will refer to the arrays I used as Williams and Le Du configurations.

My initial attempt sounded decent enough, but was thwarted by the necessity to have phase coherent files that could be both up and down mixed for various reproduction formats. In the end the postproduction team opted to use a Soundfield sps200 for re-amping and capturing additional audio for the film.[10]

For this project though with regards to experimentation and the tests used in the pre-production leading up to the recording of circles, I was not hampered by a specific brief, and all the restrictions that can ensue.

To me choosing suitable microphones and placing them in a fashion that can capture a sense of clarity and depth, whilst reflecting the energy, colour and more specifically timbre of the instrument being recorded is not only an invaluable skill, but also a great opportunity to be creative, especially when it comes to recording with multi microphone arrays.

My intention was to fully embrace the potential creativity of a 360-degree sound stage without the usual constraints one feels during a commercial project.

After all, Individual, commercial projects themselves are ethically bound to client satisfaction on the basis that one is expected to tailor workflow and practice to suit the personal taste of the composer and or producer. In reality, it has been on the rarest of occasions that the parties involved have wanted me to deviate from capturing anything other than a front facing stage for stereo reproduction.

It is also worthy to note that though the musical timbre of a given source can be manipulated in a manner of ways to compliment a specific style or genre at the recording stage, my experience has highlighted the benefits of recording an accurate representation, with high fidelity in mind. Then if necessary, the captured source can be degraded or altered to suit the production needs at the post stage.
Perhaps it's a cliché to suggest, but its better to have more to work with and then take away what is no longer required at a later part of the process, in essence something that is akin to sculpting. One must have the material in place before chipping away at something to craft it into a thing of interest that has shape and form.

In the studio environment sound is sculptured during the practice of producing a record and microphones play an integral part in capturing the material needed for this process.

This MA project has given me the opportunity to experiment with multichannel microphone arrays within different spaces and allowed me to gauge first hand how such techniques normally associated with larger ambient recordings can be utilised to gain a more accurate, spatially coherent representation of the sound sources in a way that can promote creative approaches to composition and the recording process.

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[10] The Soundfield microphone and its encoding software work with first order ambisonics. This allowed the team to manipulate the recorded sources before mixing down to a phase stable 5.1 format, which in turn could then be down mixed to stereo or mono.

Furthermore using relatively affordable equipment, I believe that an ethically viable reproduction system can be introduced to the average listener via standard stereo headphones.

Research

Ultimately I was looking to utilise a variety of compact arrays that could be used in smaller studio environments and serve as a centre focal point for the recording of 'Circles', a piece composed specifically with multichannel recording and reproduction in mind. [11]

I wanted to find a suitable array that could provide a concentrated coverage of a full 360-degree sound stage, as the idea or at least some of the conceptual thinking behind the composition of 'Circles' was to create a non-static listening experience via a series of strategic static recordings. The aim was to create a sense of movement throughout via recording the sound source, which in this case was a single classical guitar, in different locations around the said sound stage.

With this is mind I was able to narrow down my research with regards to potentially suitable arrays. In the past, I had chosen to use wide reaching microphone arrays such as a 'Fukada Tree' that utilise outriggers for larger stages. This particular technique and others that are regularly spotted at concert recordings and or studio based classical recordings are aimed at a more traditional style of recording.
Whether in stereo or multichannel, the traditional concept for recording a performance is based around placing the musicians in a specific order on the stage and the recording takes place via an audience perspective.
This 'sound stage' discussed in great detail by authors such as William Moylan (2002), is traditionally in front of the listener and multichannel recordings tend to use the rear microphones in an array to only capture the ambience of the space. Recordists undertaking such projects with a more orthodox sound stage consider the concept of 'critical distance' to be a vital part in the placement of the microphones.
The idea of 'critical distance' whereby, the direct sound source and resultant reverberant sound become equal in amplitude at a point within a given space was not something I was focussing on. [12]
Indeed, as will become evident I was looking to work with two arrays, one to capture a 360-degree image of the sound source, with a higher direct to ambient ratio and closer to the source than traditionally is considered normal practice, and one to capture ambience in a similar way to specific arrays like that of the 'Hamasaki Square'.

This though is a topic for discussion that I intend to look at throughout this paper. For now though I would only posit that such arrays as the 'Fukada Tree', and other traditional approaches for mic placement and the considerations associated with such

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[11] It was a unique opportunity to highlight how the use of multichannel recording and playback systems could be used in a creative manner. I was fascinated from the offset with regards to how phase and polyrhythmic pieces could be both freed and enhanced via the extra spatial dimension at both the pre and post stage.

[12] Unlike traditional approaches, I had no intention of placing the mics at the rear of my array at the point whereby the direct and reverberant sound became equal.

techniques, would not have been suitable to use whilst recording Neil Campbell's new suite of music.

As aforementioned, Williams and Le Du had inspired In part my first attempt to utilise an array for 5-channel reproduction. This was after I had read a paper they had originally presented back in 2000 at the 108th AES convention. The paper entitled 'Multichannel Microphone Array Design' provides detailed charts for the design of 5 channel arrays that provide continuous coverage over a full 360 degrees.
With over 220 possible configurations presented in the paper by Williams and Le Du it was easy to pick out 4 different arrays all offering different spatial coverage over the 360 degree horizontal planar.

In a similar respect to stereophony where one is expected to consider the size of the sound stage and in turn the 'SRA' or stereo recording angle, 'Multiphony', a term used by Williams, looks towards the capturing and ultimately, the reproduction of a "Smooth and continuous sound field" (Williams & Le Du, 2003, pg2) [13]over the said 360 degree horizontal planar.

The authors provide various charts that present the user with ways in which to plan out front, rear and lateral coverage and for the most part my research would suggest that very little is documented when it comes to the audio results yielded via testing variants of these arrays.[14]

As with all applications that use more than one microphone one has to consider offsets both in terms of intensity and time of arrival. These offsets can be achieved via microphone positioning and set angles, and or the use of electronic time offsets, which is applied via the finest of delay time adjustments between the front and back pair of mics within the array.

What struck me early on in to my research was the number of compact array configurations suggested in the Williams and Le Du paper that do not require any form of electronic time offset due to the coverage obtained via simply positioning the microphones at the specified angles. In the simplest of terms, these arrays appealed to me, as they were compact enough to hopefully provide the tight and coherent coverage I was seeking for a stable 360-degree sound stage. Now it was just a case of testing out a selection for myself.

In the paper the authors use the term 'critical linking' to describe how the directional microphones utilised are positioned in such a way as to create 360-degree coverage without any overlap. In reality it is the positioning of the microphones and relationships between positive and negative angular offsets as well as any artificially induced electronic time delays that are deemed necessary to provide the critical linking points and in turn map out 5 separate segments around the array.

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[13] Though the original paper was presented in 2000, quotes for this paper have been taken from the reprinted version that was released via the 'Rycote' website in 2003.
[14] The INA-5 seems to be the nearest to the array designs cited by Williams and Le Du with regards to spacing, angles and polar response patterns.

It was through considering these segments that allowed me to start thinking about where I could position Neil playing his classical guitar throughout the recording process.

With regards to testing and researching what is arguably a variation or something akin to that of an INA-5 array, I found myself spoilt for choice. The sheer scope to potentially use one of over a possible 220 configurations, and a distinct lack of audio examples, gave me a unique research opportunity. This was further enhanced by the author's admission that they believed there was leeway to experiment.

Interestingly, it is suggested that in a similar way to that of stereo recordings the users "are not restricted to the use of cardioid microphones" (Williams & Le Du, 2003, pg.12).

Though it is suggested that future AES papers would look into this, I have as of yet not come across such a paper in my research. [15]

As I have previously discussed, I was looking to utilise a variety of compact arrays that could be used in smaller studio environments on projects not normally associated with multichannel recordings. Through this process of testing I would then select one main array to serve as a central, focal point for the recording of 'Circles'.

As I was also very much aware from the outset that I had the room to experiment with both the polar response patterns of the microphones, and their positioning within reason. The idea of phantom imaging between speakers became more of a point of consideration as it appeared to be tied in directly with the concept of 'critical linking'. Which is necessary for full, smooth coverage and is associated with directivity, measured offsets and the practicality of phase stability when one considers up or down mixing. The latter though was not in my remit and I simply wanted to find what I considered to be the best sounding, most musically interesting solution for both 5-channel reproduction and for reproduction via headphones.

With the following in mind, I set out to conduct a series of tests. If the use of different polar patterns throughout the array and indeed the repositioning of rear microphones caused colouration to the signals via overlapping images, spectrally split or otherwise, then so be it.[16] As long as the sources being recorded sounded good enough to utilise on the recording in accordance with the wishes of the other parties involved.
The reality was that from an early stage Neil and I had a philosophy that was biased towards the music. How it sounded overall and what it could offer as a listening experience, far outweighed the science behind the theories, though there were other factors to contemplate.

"One of the most important aspects which should be considered in preparing a multichannel recording is the decision as to which perspective to present". (Sitek & Kostek, 2011, pg.366)

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[15] That is not to say that one does not exist.

[16] As at many points throughout this project, I had to remind myself that ultimately I am interested in how the techniques could be used to improve upon the art of record production. It was not an MSC that one was undertaking, but an MA, and I wanted to find affordable ways in which other engineers could engage such techniques from an ethical standpoint.

As aforementioned from the outset I was looking towards working with a full 360-degree sound stage and wanted to envelop the listener in a way that pushed creative boundaries. I had no interest in what many coin as the 'direct / ambient' approach. This particular perspective "attempts to recreate the impression of taking part in the event"(Sitek & Kostek, 2011, pg.366).

This to me is tied heavily in with the more traditional approach to multichannel recording and the concept of critical distance, mentioned earlier in this paper, whereby as Holman points out:

"The front channels are used mostly to reproduce the original sound sources, and the surround channels are used mostly to reproduce the sense of spaciousness of a venue through enveloping the listener in surround sound reproducing principally reverberation" (Holman, 2008, pg.87).

Neil and I had already began to discuss a vision for how circles should be presented and reverberation was not high on the agenda, in fact the only real criteria laid out at the beginning by the composer was the wish for definition and clarity presented in all the reproduction channels. Though as per discussed, he would leave spatial matters in my hands.
From my perspective I wanted to capture a 360-degree image of his classical guitar at different points around the chosen array acting as a centre focal point within the recording space and this would of course include room reflections and diffuse, uncorrelated sound. That did not concern me though, quite the opposite, as I was already starting to formulate a combination of techniques that would suit both the stipulations of the composer and my own vision.

It was apparent that I should make use of close mics alongside the chosen arrays from the Williams and Le Du paper to ensure from an ethical point of view that the artist's wishes to capture both clarity and definition were attained.

Sitek and Kostek (2011) identify the other perspective cited by Holman (2008) as the 'direct sound all-around' perspective, and as suggested:

"The second perspective is to provide the listener with a new experience that cannot typically be achieved by patrons at an event, an 'inside the band' view of the world. In this view, all loudspeaker channels may be sources of direct sound. Sources are emitted all round one, and one can feel more immersed" (Holman, 2008, pg.88).

This concept of 'direct sound all around' best describes the listener's perspective for both 'circles' and the some of test material I have submitted, including Mikes's piece, 'Lady Wind'. Though all pieces involved capturing an image of direct to reverberant sound on each record pass, the recording was subjectively choreographed around a 360-degree sound stage.

Research though according to Holman (2008) suggests that people prefer the former perspective to the more actively immersive 'direct sound all around' perspective. This information, was collated by the 'Consumer's Electronics Association'[17] and although

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[17] No date is given.

no real reason is hypothesised for why this may be the case, Holman posits that "the widespread audience may not yet be prepared for a fully surrounding experience" (Holman, 2008, pg.88).

From a critical point of view, the issue with such a suggestion is two fold. Firstly the consensus is that there is a lack of experimental surround music available,[18] which in part is due to a lack of reproduction systems that are accessible to the average listener. Therefore how can such assertions be made, one would only know if the audience was 'prepared' if they had material to listen to in the first instance, and secondly. There is a lack of research currently accessible that provides audio examples using a variety of arrays to give production houses a clear and objective way of deciding which array is best suited for capturing multichannel audio. This makes it difficult for the average producer or studio engineer to introduce such techniques to everyday record production and therefore the end listener once again does not get the opportunity to listen to such style recordings.[19]

Kaiser et al (2005) conducted a series of tests on a variety of instruments and ensembles simultaneously using different front arrays for direct sound whilst also simultaneously testing a selection of arrays to capture ambience at the rear of the chosen test space. Though the tests were based on a direct / ambient perspective with a front facing sound stage the results were interesting and the findings, all be it subjective, assisted in my own series of tests to a certain degree.

More specifically they reinforced what I had found and helped lead me to the decision that a final creative piece of music would come about via using a combination of techniques.

Kaiser et al (2005) describe their work in this paper as an 'informal comparison'. From the outset there is an admission that they wished to "gain experience in using various multichannel recording techniques" (Kaiser et al, 2005, pg.2).[20] Though the paper was presented in 2005, this is arguably still the case for many engineers and this admission presented in the paper only reinforces my earlier declaration that there still is a lack of recorded test material.

Though they cite the 'feasibility' and 'practicalities' of such comparative recordings in both the test space and potential use within a concert hall, it is the comparative part that interested me in that they suggest 'perceptual evaluation' and the 'characteristics' of each array is 'evaluated' and 'determined'.

It was found that subjects preferred the 'Fukada Tree' overall with regards to the front array. This was due to the array yielding what was seen as a decent low-end frequency response, a good balance with regards to the width of the recorded sound sources and amongst other attributes the listeners felt, that such an array presented a decent amount of localisation with regards to the sound sources. The recordings

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[18] This is especially the case with regards to music outside of the direct / ambient approach that has been recorded with multichannel reproduction in mind, and for the most part most music recorded for multichannel reproduction works with techniques aimed at capturing a front facing sound stage, normally within the classical genre.

[19] Even without the home theatre system, or the idea of using headphones after binaural encoding, there is a lack of experimental music played back in cinemas, etc.

[20] Both front arrays for direct sound and rear arrays for ambience were tested, though I was only interested at this point with the front arrays for capturing direct sound.

yielded a "solid centre image" and gave the listener a "pleasant spatial impression" (Kaiser et al, 2005, pg.13).

Out of the other techniques selected, 'OCT' (Optimised Cardioid Triangle) and a near coincident array, it was the INA array[21] that gained the second most votes In terms of personal preference.

However, as all the tests were done via positioning the various musicians on a sound stage in front of the arrays and with the paper not touching upon the idea of 'continuous' 360-degree coverage for my preferred approach of the 'direct-sound all-around' perspective, one could argue that there was little to take from the findings.[22]

In summation the authors suggest:

"The INA-3 technique was the second-most preferred in general. The localisation accuracy is worse than the OCT-inspired or Fukada Tree techniques (probably due to interchannel crosstalk), but it provided 'openness' and a pleasant spatial impression. It can be useful for recording of instruments like solo piano" (Kaiser et al, 2005, pg.13)

For me, just the suggestion that the technique could be useful in recording a solo instrument was enough to reinforce my decision that similar compact arrays should be tested.

Furthermore, it is stated that the test was potentially compromised due to the choice of microphones. The researchers chose to use pencil condenser mics for the INA-5, whereby larger diaphragm microphones would yield a better low frequency response and therefore the suggestion of the array sounding 'thin' may have been averted.

It is also notable that with regards to localisation that the authors criticised the INA array. Through personal experience I know that the 'Fukada Tree' yields great spatial results whilst set up at both a decent height and critical distance from the intended sound source. However from a critical perspective, there is nothing to suggest that such an array would be as effective if the said sound source was much closer and the array was lowered in height.[23]

After all Neil wanted clarity and definition, and my intent was to place him close to the array.

With the INA-5, or more specifically one or more of the Williams and Le Du configurations now by all accounts being the most feasible to investigate further. I wanted to look at other up to date research that examined other techniques omitted from the 2005 paper by Kaiser et al.

I was interested in using the 'Soundfield' microphone housed at Vestry Hall. This was in part to explore the recording of individual musical instruments with the pinpoint accuracy of ambisonics. [24]

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[21] Again, this was the nearest relative, for want of a better word to the arrays suggested by Williams and Le Du.
[22] Especially having already decided that a 'Fukada Tree' was not compact enough for my intended sound stage.

[23] My theory on this would be that with the outriggers involved, such an array would be far too wide in terms of the captured image, and positioning a sound source around different segments of the array for the full 360-degrree sound stage would become very unbalanced.
[24] Previous experience of using Soundfields was for concert / location recording and for using with postproduction jobs on films.

In 2011 Andrzej Sitek and Bozena Kostek presented a paper that investigated multichannel microphone techniques for recording an instrumental ensemble and a choir. They decided to compare a Soundfield, INA-5, Polyhymnia Pentagon and Corey/Martin Tree. The 'Corey/Martin Tree' was subjectively voted the best array for the series of recordings undertaken, though once again this did not deter my wish to further investigate some of aforementioned configurations suggested by Williams and Le Du.

For one, they were still in my mind more compact and could therefore be tested in smaller live rooms and secondly with over 220 possible variations to choose from, one could investigate a more unique array.[25]

With regards to first order ambisonics, and the use of a soundfield microphone it is suggested from the investigation that it was:

"Consequently rated as the worst system. The SoundField was the only coincident system used among the chosen surround techniques, what this indicates is that for the purpose of surround musical recordings, it is more appropriate to use spaced microphone arrays"(Sitek & Kostek, 2011, pg.376).[26]

This though did not deter my choice to incorporate the Soundfield V microphone into some of the tests I undertook or indeed the final recording of Circles as I was interested to see how the recorded results may be used in combination with the chosen arrays.

In the past I had personally found the use of the sps200 Soundfield microphone was almost too clinically accurate and that the lack of spaciousness was not as appealing to other multichannel approaches.[27]

However, the pinpoint tri-dimensional recording to b-format and subsequent encoding to 5.1 would also be a useful comparison to that of the dummy head and array once the latter had also been binaurally encoded.

Again the INA array, this time, as a full INA-5 multichannel recording system, was voted second favourite alongside the 'Polyhymnia Pentagon'.

Though, perhaps the most interesting and relevant information that I digested from the authors paper was there use of both the 'direct / ambient' and 'direct-sound all-around' approaches.

On the whole the majority of sound sources were captured via the various arrays that were set up from the direct / ambient perspective. On reproduction as per usual, the listener can then attempt to localise the positions of the sources on the sound stage and try to gauge which array provided the most accurate image.

However, the research also utilized the 'direct-sound all-around' perspective by recording various sound sources via spot mics and then in turn placing the recorded sounds within the 5 channel reproduction system via the use of surround panners.

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[25] Investigating a unique configuration of one of the suggested arrays could potentially add an amount of ethical validity to my research paper as a whole. One of my intentions was to provide future researchers with audio examples of such arrays, something that I have continuously cited as being an issue as there is a lack of such examples.

[26] First order ambisonics or, 'W, X, Y & Z', b-format has often been cited as yielding a very low spatial impression.

[27] This may not be the case with combination approaches to HOA or 'Higher order Ambisonics'.

As with other research into multi-mic arrays, a full 360-degree sound stage was not fully utilized. However, by mixing together the two perspectives, it can be argued that they did move away from the orthodox style of recording and mixing associated with traditional ensemble recordings and did in fact blur or rather colour the images between speakers. This was definitely something that could factor into my recording of 'Circles' as I planned to utilize the previously mentioned combination of techniques incorporating close mic techniques for clarity and arrays for spatial imaging and depth.

Sitek and Kostek conclude by stating that:

"The obtained results of the paired comparison test show that mixing together 'direct-sound all-around' and 'direct/ambient' approaches results in difficulties to differentiate between various multichannel systems and also changes the criteria of choosing the best quality technique. This could be caused by a difference in spatial envelopment very important in multichannel recordings"
(Sitek & Kostek, 2011, pg.377).

It is also suggested that the 'experts' had difficulty differentiating between mutli channel techniques when the less orthodox approach of 'direct-sound all-around' was in the mix.

Insightful as part of the research currently out there is with regards to testing multi channel systems, critically they all seem biased towards capturing audio via traditional sound stages.
There is also very little discussion about the musicality of such techniques and how multichannel recording can be used as a form of creative record production.
'Envelopment' and a sense of 'immersion' need not always be associated with transporting the listener into the concert hall.

'Circles' was about creating a musical experience that was not limited by a two-channel reproduction system. There was no burden with regards to attempting to recreate or simulate a particular space.
Instead it became a case of searching for the most viable techniques to create a unique listening experience, and hopefully such a production would lead on to further exploratory projects.

For this particular production our intention from the beginning was not to be constrained in any way, experimentation was going to be key.[28]

Please refer to the second Paper entitled 'Personal Testing, Practical Research & Development (a)'

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[28] Critically I feel that a lot of the existing research and test recordings do not push the boundaries of such techniques as multi mic arrays in a creative manner.

Recording 'Circles I, III & IV'

The suite was recorded using a variety of techniques. This was a deliberate choice that served to meet a series of requirements and to lay the foundations for future research. It also allowed all parties concerned the scope to further develop the suite of music in the future.[29]

From an ethical perspective the use of two 'Rn17 Se Neve' condenser microphones, allowed me capture a direct sound that satisfied the request of the artist to gain both clarity and definition, something that as aforementioned had been stipulated very early on by Neil.
From my perspective the arrays used in isolation had yielded excellent results in the smaller live room environments of B2 and B3, however in vestry hall it made sense to not take the risk, and the use of a spaced pair [30] could be easily positioned via the surround panner in pro tools to reinforce the 360-degree ambient capture of the classical guitar via the array. The close microphones could easily be blended at the mix stage, and my hope was that they would in fact help to enhance localisation on playback via the 5-channel reproduction system.

Using the soundfield microphone and ku100 served three main purposes. Firstly, at a later date if I was to undertake further research into Ircam tools like 'Spat' the dummy head recordings could be used as a comparison and or serve as a direct to headphones binaural mix for the artist. In a similar vain, an ex colleague of mine is currently working on an ambisonics panner and binaural encoder. By recording and group editing all the b-format parts alongside the arrays, etc., I would be able to FTP him the suite for testing.[31]
Though as a side note with regards to the above, I am currently fairly happy with the results the standard Ircam Hear tool is providing of the mixes and see a future in such a delivery format.

The soundfield and KU100 were also very useful at the editing and mix stage in helping to identify and track the various guitar loops played at points around the circle that I had marked out. This was invaluable with regards to blending close mics to the array to keep a sense of localisation in line with the centre array.
The specialist microphones were also used on occasion to add extra character by blending into the mix, though for the most part it was the soundfield that was utilised after the b-format had been converted to 5.1.[32]

The array highlighted in fig 4 had proven itself to be in my mind the best array for 360-degree continuous coverage and was therefore used at the centre of the circle I had mapped out in vestry hall. Baffle boards were placed strategically around the outer circle to curtail the acoustics of the room, though vestry hall does have a reasonable sound with little colouration. The main array was made up of five U87s all set to cardioid and the large diaphragms served their purpose well with regards to capturing low frequency and body. Six QTC-1 omni microphones were used as an

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[29] The plan is to release it commercially when the artist is 100% happy.
[30] With cardioid patterns as opposed to omni.
[31] Due to current work commitments Stefan was not able to present me with any test conversions at this time.
[32] No elevation or dominance, etc was added at this time. Again such manipulation may take place on future mixes.

ambient array and were positioned around the outer bounds of the circle, all pointing in towards the centre of the array, which in this case was the ku100 dummy head. The Soundfield V microphone was placed directly above the dummy head and set to an 'inverted' position via the soundfield hardware.

(A video clip highlighting the above can be found within the Folder marked video clips submitted on the USB storage device. The video is entitled 'Demo of set up in VH'[33])

Fig 8: Setting up to record circles. (Brocklesby, M, 2014)

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[33] Though in the video clip I describe the array as an INA-5 this is not technically true as aforementioned throughout this paper the INA-5 is a close relative, the array used is based off configurations laid out by Williams and Le Du).

<u>Circles I</u>

All of circles was recorded a loop at a time and involved moving Neil into different positions around the array at the centre of the circle marked out in Vestry hall. As you can imagine there was a huge amount of editing involved when it came to creating the form of the pieces and in essence bringing the music to life. The cyclic movements, that one could compare to 'Electric Counterpoint' by Steve Reich as a contemporary point of reference, were edited as groups consisting of 19 channels at a time. Though I started working at 32 bit 88.2KHz, I found myself soon moving down to 48KHz because I needed the extra voices to work with in Pro Tools.
In all after editing the three chosen pieces the project files added up to around 70GB. This would have been larger though Circles II was dropped on account that as a sonic experiment it was not working on the day and as agreed, like so many elements of this project, the suite has aspects that are still work in progress and circles II may well be revisited.

The piece mainly comprises of three lines. The first two loops are identical, though one is running at 200bpm whilst the other is at 200.2bpm. Both parts start at the same time but very soon begin to deconstruct and as they morph in and out of phase, new patterns, shapes and timbres are created. The 'spectromorphology' that occurs over time feels in places like a rhythm generator and though the piece does meet up and realign far earlier than I have started to fade the track, I wanted to keep it in line with Neil's vision for an 'infinite' piece of music.

(Please refer to video clip entitled 'Neil's vision for Circles' which can be found within the Folder marked video clips submitted on the USB storage device).

The third line or more specifically acoustic guitar[34] loop was taken from Circles III and served its purpose well as it was in a higher register and moving along with the loop at 200bpm in sync, again assisted in creating some interesting changes in timbre.

We had initially tested recording a guitar loop at 200.5bpm but found that the deconstruction caused by the shifting out of phase occurred to fast. Though arguably future recordings could investigate smaller increment changes such as 200bpm against 200.075 for example. This though would take far, far longer to realign and would perhaps be more suited to an installation piece.

Once all the clicks and pops were edited out at the loop points I chose to blend together the centre array and converted soundfield files. The array provided a sense of depth whereby as with all the recordings the slightest use of the ambisonic style recording provided a pinpoint localisation. The soundfield arguably presented some height to the mixes due to its elevated positioning, though at no point am I suggesting that a 3D sense of periphony was added. With regards to the blend, as with all three mixes the array was slightly higher in the mix as the spatial openness presented on the 2d horizontal planer added just the right amount of depth. For this movement, very little of the outer array that was encircling the performance was added due to various unwanted artefacts that coloured the overall sound.

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[34] A 'Santo Martinez' classical guitar.

As we were trying to attain definition, perhaps more so in this piece than any of the others, in an attempt to gain clarity over the shifting musical timbres, I had the 'RN17s' set highest in the mix.

(For an example of 'Circles I' being tracked please refer to video clip entitled 'Example of playing in loops for constructing form' which can be found within the Folder marked video clips submitted on the USB storage device).

Circles III

This movement is a variant on 'circles I' and again Neil was recorded playing in different positions around the centre array.
On this occasion he played patterns of very slightly different lengths in each of the various positions to create a constantly changing series of rhythm and pitch relationships. The piece used only the one click track set again to 200bpm[35] and worked to a 6/4 time signature, and then as with the other movements, the form was constructed at the editing stage.
Careful attention to detail was required with regards to the grid and specific metering when it cam to editing the loop points of the various loop lengths to ensure a flowing polyrhythmic piece.

After removing the nightmare clicks at pops it was once again a case of blending the various sonic images captured via the various microphones. The 2 bass lines that give the piece more of a song based feel by anchoring the movement mid way through make more use of the outer circle array. The outer array assisted in adding a certain energy that helps lift and drive the arrangement. Though once again in line with Neil's wishes more detail was attained through bringing up the two close mics in the mix. The centre array was blended somewhere between the 'RN17s' and the outer array in terms of levels.

The patterns, chords and harmonics used less of the outer array and more of the centre array with regards to capturing ambience. However as with the main loop patterns in Circles I, the close mics were highest in the mix. [36]

Towards the end of the piece the two tremolo style parts are introduced to add a different shade and texture to the movement. This addition makes use of the soundfield 5.1 decoded files alongside the centre array and outer array and has the effect of 'softening' the piece after the drive of the bass lines.

In the mix Circles III attempts to make use of giving the listener a sense that the room is 'opening up', though all pieces aim to immerse the listener, it is this piece that really made use of the outer markers. On such occasions I would artificially enhance the sense of ambience via attenuating the QTC-1s placed nearest to Neil on the outer array, thus allowing the adjacent mics furthest away to capture the sense of distance.

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[35] This was to ensure cross compatibility with' Circles I'
[36] Though, as can be heard Circles III noticeably utilises more of the centre array within the mix.

The outer array was also set up at head height whereas the inner array and close mics were set to the height of Neil's guitar.[37]
Having the outer array positioned higher added a sense of 'airiness' to the mix when utilised.

One aspect that I would like to mention was the deliberate choice throughout the recordings to embrace the mechanical noise coming from the classical guitar. It is perhaps a cliché to use the term 'organic', however the mechanical noise became an increasingly more intricate and interesting part of the loops whilst playing back in repetition.

(For an example of 'Circles III Mechanical noise on Guitar please refer to video clip entitled 'CIRCLES III example of Mechanical noise on Guitar which can be found within the Folder marked video clips submitted on the USB storage device).

Circle IV

All the pieces are technically 'static' with regards to how the sources were recorded, though alongside a sense of immersion and envelopment there is a definitive sense of movement (non-static) and 'Circles IV' highlights this sense of movement to a greater extreme.[38]

The piece consists of a chord sequence of six chords, each of six notes, which are played as arpeggios. The idea was that each note would emanate from a separate space on playback. To achieve this, I positioned and recorded Neil in six different positions around the array though I was conscious that with only having a 5-channel reproduction system set up to the ITU-775 standard, the final part of the sequence would have to be positioned slightly different to gain the fully desired effect.

Starting at the front of the array and moving Neil around the microphones in increments, the positioning corresponded so that the playback of the notes in the sequence would move in a clockwise motion from the centre speaker all the way around until beginning again back in the centre. To achieve this I set the panner from the close mics recording the 6th note to be dead centre and cover all speakers at once. With Regards to the array recording of the sixth sequence, Neil was positioned directly centre at the rear of the array whereby there is a notorious sonic hole at the reproduction stage with regards to the rear speakers and where one finds it hard to localise sound.

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[37] The inner array was set slightly higher than the RN17s to account for dispersion patterns.
[38] With Circles being a co-production, is it right to have a favourite piece? One may argue that all the movements should have the same attention to detail exacted upon them. However, this for me was a stand out piece that demonstrated the true potential of multichannel recording and mixing for surround.

The Sixth note was also the highest in pitch, so having it effectively 'ping' back in all speakers before the sequence effectively starts again seemed like a creative way to deliver on his initial vision and idea for how it should sound.[39]

As the track progresses patterns referring to Circle I start to emerge and slowly fade into the mix, a sort of polyrhythmic rain, before eventually taking over the piece. Eventually the original sequence drops out and a final loop pattern enters the fray.

The track finishes with a couple of the initial patterns introduced and fades after a couple of cycles. At that point it is mainly the array mics, soundfield and outer array that are left in the mix.

This is in total contrast to the opening whereby once again the close mics play an integral part in defining and focusing the arpeggios. Though such definition helps with localisation for the listener the array once again provides the width and depth all be it on a 2d planar.

Very little was applied to the mixes with regards to EQ and dynamic processing, as I did not wish to overly manipulate the naturalness of the recorded soundscape.
A simple 5.1 master fader was added to the session and EQ was inserted to slightly brighten the guitar, which in turn does aid the localisation process for the listener, though this was done as well to satisfy Neil with regards to how his guitar sounded. A very slight amount of compression was added to gently even the performance as a whole, a deliberately slow attack and release time were set to avoid any noticeably unnatural shaping of the overall recording.

A surround scope was also added to measure phase coherency, though as aforementioned any severely negative readings heading towards -1 were not an issue as I was not planning to up or down mix for the sake of different format reproduction.

For the sake of research though, I can say that on the whole the arrays involved tended to lean towards the healthy and stable side of between 0 and +1.

Before moving on to the final sections of this paper, I just wanted to let you as the reader know, that I deliberately chose not to include phase scope readings, pictures of the phase scope or any information pertaining to particular panning and the placement of sound sources for the most part.

This was simply because I feel that it can cause the listener bias with regards to localising the sound on playback, I would rather you enjoyed the movements for what they are and make your own mind up.

All the arrays stayed in place, and the microphones used were hard panned to the corresponding speaker with the exception of the outer array that was used sparingly throughout the mix to enhance a sense of spatial depth and although again the 6 mics in the outer array were hard panned to specific speakers it should be noted that without a 6.0 playback system that the rear centre, added very little in the way of reinforcement as it did not have its own reproduction channel. On occasion this centre

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[39] Though a compromise, at this stage we are both happy with the results.

rear mic (CS) and whatever it captured could be moved via the surround panner in a creative manner to enhance a sense of space.

Development (b), Critical analysis & Conclusion.

Originally the idea to examine microphone design for capturing a 3 dimensional image of sound, with the specific concept of 3D audio reproduction in mind was appealing.
However, Due to the specialist tools required with regards to mixing, reproduction, and delivery systems it seemed best to focus my intentions on a more achievable objective.[40]

With regards to the proposal first submitted, the research undertaken did stay faithful, and stick to certain aspects that were originally outlined as points of study.
Firstly, it was questioned whether recordings captured via multi-microphone arrays (MMA) could be effectively played back on headphones after the surround sessions had been binaurally encoded?

The answer is yes, to some extent.[41]

There is an issue with regards to the fidelity of the audio after binaural conversion had taken place. On listening back through to the pieces on headphones, one can notice a definitive loss of quality. This is especially noticeable at lower frequencies and warrants further investigation. There is also a definitive difference when it comes to sound localisation and a sense of 'spaciousness'. This is not to say that as a reproduction format it failed, far from it.[42]

Static recordings did appear to translate better than non-static, at least this appeared to be the case when simple comparison tests were ran between the encoded arrays and the ku100 dummy head. This was a result because accessibility is an ethical consideration. With the arrays translating to a decent degree, one hopes this would allow the average studio to enter into binaural recordings with affordable condenser mics and the £30 Ircam Hear plug-in.

Though, once again the user should be aware that such an encoding process has its limitations.

On the plus side, it does allow multi channel recordings to be played back via an accessible reproduction format,[43] but the tri-dimensionality of binaural headphone reproduction is very different to that presented on the standard horizontal 2d planar via a 5.1 speaker system. This though is perhaps not a bad thing and rather than trying to recreate a sonic replica of the surround system, is it not just possible to accept it as

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[40] Using what the University had to offer

[41] This was aside of the difficulties associated with measuring such descriptions as 'enveloping' and 'Immersive'.

[42] Please listen to the binaurally encoded version of 'Circles'. Circles IV has translated fairly well. It is definitely not the same experience as listening back via speakers, but I would suggest that it should be treated as a unique listening experience of its own, Personally I find it more enveloping than listening back to stereo mixes.

[43] As aforementioned in this paper, the Ircam Hear tool certainly allowed Neil and I to avoid encoding every mix edit to Dolby AC3 or to DTS, thus allowing us to easily confer on the progress of the mixes via passing a simple binaurally encoded stereo file back and forth over the internet.

a new listening experience? It does have its own unique selling points after all. For instance, when comparisons are made to reproduction via speakers, listening to multichannel productions via headphones eliminates the problem of having only one specific 'sweet-spot'. The flip side is that there is a loss of spaciousness, and envelopment that one can gain a sense of whilst being surrounded by speakers in a room, and debatably headphones offer a less sociable experience.

Critically, one could have looked into a more scientific way of measuring and analysing the listening tests, and the subsequent responses that were attained. Though all the comments received from the participants of the listening tests were purely subjective, could it have been possible and beneficial to conduct more tests with a higher rate of participation and a wider demographic?

Having not sent out listening tests that used non-static material could be seen as a definitive flaw in the research. There is a high probability that the participants would have found it easier to differentiate between the encoded arrays and the ku100 when any moving sound sources were involved due to the limitations of both the chosen encoder and the known spectral holes present both laterally and behind the listener.

My own thoughts and findings throughout were based off both tacit knowledge and current research in the field of spatial audio, but once again without any specific objective form of testing and measuring such findings, it is arguably, purely opinion and highly subjective.

Originally it had been outlined that part of the research would examine which multi microphone arrays would work best through the various encoders that were going to be tested.

Again, to an extent this was investigated, though only one encoder was examined. All the arrays tested were ultimately put through the Ircam, but there is room here for future research with regards to both the arrays and other encoders on the market. After further comparative testing those involved in the research could spend more time looking at how different surround panners on the market could be used to gain a more accurate translation between multi-channel recordings, mixes and binaural encoded reproduction systems.

Arguably at least one part of my research did involve accurate planning and execution in terms of using tape measures and protractors to set up the arrays. There is definitely an opportunity to investigate deeper into how specific angles could be broached and positioned within the various surround panners. Would such differences have an even greater effect on the accuracy of the reproduction system both via the ITU-775 speaker system and encoded into headphones? What impact would there be with regards to phantom imaging?
There is also scope to investigate attenuating various amplitudes with regards to microphone intensity levels, depending where the sound source is positioned in relation to the furthest mic away in the said array. Would such alterations help to smooth the continuous coverage of a sound source over the 360-degree horizontal planar and would this in turn help to provide a more realistic image of the recorded sound?

Finally in the original proposal it was posited, whether or not such techniques as using multi microphone arrays could be utilised to record styles of music not normally associated with such techniques, and whether such arrays could be used in smaller studio environments?

The answer to this is a resounding 'yes'. The best results are still attained in a decent sized recording space when it comes to working with spatial audio, perhaps this is obvious, however basement 2 & 3, which are a lot smaller than the average commercial live room provided surprising results.
The research findings would suggest that the compact arrays are worth experimenting with on future productions with both stereo and multi-channel formats in mind.
Again, from a critical point of view, to make such techniques work in less orthodox environments, one needs to experiment in a creative way. An example of which would be the use of a 360-degree sound stage.

The biggest alteration to the original project as a whole came about via having a central focus develop. Ultimately the central focus became the recording of 'Circles' by Neil Campbell, which the composer hopes will be his next commercial release.

With regards to how Circles turned out as a whole, both the composer and myself are extremely happy. It is felt that in comparison to other commercially available work like that of 'Electric Counter Point' by Steve Reich, that the use of multi microphone arrays with surround reproduction in mind worked very well for this type of cyclic, minimalist music.
Having the full 360-degree sound stage to work with, allowed for experimentation and in a way the music felt less cluttered and provided an open environment in which to play with polyrhythms, pitch and phase relationships.
Aspects that can sometimes be so easily misunderstood on a 2-channel system suddenly came to life and hopefully the end result is that those listening feel immersed in the music.

The suite of music still needs adjustments[44] before being mastered and released and Neil would like to examine the possibilities of performing the movements live. This will require looking at how the 'sweet-spot' could be enlarged so that an audience could be suitably enveloped in such a live performance.

One would now agree to a certain extent that the findings of Kaiser et al (2005) were accurate, this after having the chance to listen to the arrays. They suggested that localisation issues existed with the INA-5 array and this would appear to be the case with other variations of the compact arrays tested. Though all parties involved still feel that the chosen array was the most suitable for the recording of 'Circles'.

The placement of the close mics into the various speakers via the surround panners helps the listener to localise the sound sources extremely well. They also aided in providing a clear and defined sound of the guitar and along with the 360-degree image caught via the centre array, the overall sound has character[45] and depth.

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[44] As is so often the case in professional practice, the artist which in this case is also the co-producer, wishes to attend the final tweak / mix session to assist in finalising the pieces. Personally now that I have had time to listen back to the tracks, I will be looking towards lowering the ambient array in the mix in an attempt to reduce noise. This may well also require attenuating the centre array, if only slightly, whilst bringing the direct mics up in the mix.
[45] Pertaining to the room sound.

As cited by Sitek and Kostek (2011), the 'direct sound all-around' approach may well be seen to hinder the listener's ability to distinguish between the techniques utilised in the said recording. Such considerations did not hamper the recording of circles and instead the approach did help to enhance the experience of listening to a 360-degree sound stage. All the microphones played a part, as did the strategic positioning of the sound source, which was recorded in different segments around the array.

Originally Neil wanted a full Circle and the standard ITU-775 system configuration has obvious limitations. Such future recordings pertaining to such a brief would perhaps be best suited via the use of a 6.0 playback system or higher. That would allow further investigation in to 6, 7, 8 or higher mic array configurations.

Finally, in future it would be beneficial and more valid with regards to continuity and consistency, to test all the various arrays examined within the same acoustic space and with the same microphones. Though hopefully all the audio examples and feedback presented in this paper, regardless of its subjective nature, can be used to assist those interested in this field of research with future studies.

Ethics

'Circles' was written and performed by Neil Campbell. The work is copyrighted and Neil has given me permission as co-producer to use the material at this stage for educational and research purposes only.

The music is an original body of work and the artist requests that unless special permission is granted by him directly that the material is not to be played outside of the University. He also prohibits any reproduction of the said material without prior consent.

The intention is to commercially release the finished body of work, and though any alterations will likely take place in a studio outside of the University. All parties concerned will need to discuss mechanical copyright. As co-producer, I have kept back ups of all the session files but will still look towards gaining clarification as to whether the University of West London has any specific stipulations with regards to work that took place within its studios. The composer, Neil Campbell and myself are happy to participate in further work with the university and would be happy to credit the London College of Music (UWL) on any future publication of the said material.

With regards to all of the other audio examples I have submitted as part of the research I undertook, all performers and those involved in one capacity or another have granted me permission to use the excerpts on the condition that said examples are only used as part of this paper.

Those participants involved in the listening tests have remained anonymous, though nothing was stipulated to the contrary.

All comments, feedback and opinions received from the artists, colleagues and peers have not been falsified in any way. The appendices within the research paper present word for word commentary from those that gave responses, though it is worth mentioning that the original responses were copied and pasted into a separate word document for collation purposes.[46]

With regards to the use of university facilities, I tried my upmost to spread my time in different studio facilities so that the said facilities could be utilised by other peers in a way that everyone felt they could gain a fair amount of access. This of course is a fairly difficult task at the best of times, though I would like to take this opportunity to thank all those that assisted me with regards to swapping dates and session times on the rarest of occasions that it was of the upmost urgency to do so.

As aforementioned throughout the paper, though perhaps not touched upon in the greatest of detail. I would like to think that some of the research I conducted was ethically viable from the point of view that such undertakings were affordable and therefore more accessible to those that wish to attempt such tests themselves. By this I am referring to the use of the £30 Ircam software and the occasional use of relatively cheap condenser microphones, as well as the fact that some of the tests took place in smaller live rooms. Not everyone has access to the KU100 dummy head, the

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[46] In no particular order, hence the participants not being listed in a chronological order.

Soundfield microphone and encoders, nor many of the more expensive microphones I had at my disposal. It is also equally not a socially responsible idea from an ethical standpoint to expect anyone wishing to further the research I undertook to have access to facilities like that of Vestry Hall.

Though I feel that I did chose the most suitable array for the recording of 'Circles', and that the other microphones involved were effective in bringing about a result that satisfied the composer and myself as co-producer. I feel that there is plenty more options that could be explored and would like to think that this body of work and its findings, all be it fairly subjective, could be useful to further students that wish to undertake their own research into multi microphone arrays.
Williams and Le Du (2000) present many configurations for such designs and I feel that this could be a good place to start with regards further research or those that would like to broach the field of multi-channel recording for the first time.

This can also be said of the very basic exploration I undertook with regards to using binaural encoding as a means to provide multi channel audio recordings and mixes with a more accessible reproduction format.

Finally I would like to thank all those that allowed me to partake in sessions they had organised, whether allowing me to set up an array of my own to test or simply to get involved with sessions that were related in some form or another to my own research, I am truly grateful.
My thanks is also extended to those that assisted me on the occasional sessions, to those people that were just interested and sat in to offer another set of ears and all those that generally engaged in thought provoking conversation.

In no particular order a special thanks goes to, David H. Padilla Vergara, Neil Campbell, Mikes Sakelliou, Drew Whale, Jules Manser, Dr.Simon Zagorski-Thomas, Dr.Andrew Bourbon and of course my supervisor, Sam Proctor.

Last, but certainly not least though, my biggest thanks goes to my old colleague at Binarycell, Stefan Kazassoglou. Stefan inspired me in countless ways, and introduced me to working with multi channel audio. Neil and myself would also like to thank him for his help with the final authoring of 'Circles' to DVD and Blue ray.[47]

Though the University had the facilities providing software to convert files to standard AC3 (Dolby digital) format via 'Apple Compressor'. Stefan gave us the option to convert to DTS and Dolby (for the DVD) and also gave me the option of authoring the PCM files to Blue ray.

As the project has had to consider the wishes of the artist from the start, I thought it would be best to represent his work with the best audio quality in mind.

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[47] Stefan will be first in line when it comes to the job to author the potential commercial release and again from an ethical perspective it was good to give the composer an idea of what is within our capabilities, i.e. what options we have with regards to formats, fidelity, etc. This being potentially Neil's first commercial venture and in turn financial outlay for a surround sound product.

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London College of Music

MA Record Production

M-Level Project

MU70164E

Paper 2: Personal Testing, Practical Research & Development (a)

By Mark Brocklesby (21224708)
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Contents

Personal Testing, Practical Research & Development (a)

Before recording Circles I decided to test different arrays[48] in a variety of situations. I also chose to conduct basic comparison tests between the ku100 dummy head and the arrays made up of anything between 5 and 8 microphones. The arrays were encoded to binaural via the Ircam hear plug-in[49] and could easily be AB tested between the Neumann Dummy head.

The tests were conducted with a wide selection of microphones to capture both static and non-static sound sources and the recordings took place in many different size studio live rooms to see how effective the arrays performed in less orthodox surroundings.[50]

I would like to make it clear from the start that I have no interest at this point in the complex measuring and physiology involved with HRTFs. HRTFs are unique to each individual and though localisation plays a role within this project, I do not deem it so important that one would get lost in the depths of using more advanced tools such as Ircam's Spat for Max/Msp in an attempt to arguably recreate a personalized, unique listening experience.[51]

The standard Ircam Hear tool suffices for now, as it encodes via algorithms based on preset HRTFs that have been measured off averages.[52]

Thus, my primary intention at this stage is to use the basic encoder as a tool that ultimately allows the average listener access to multichannel recordings and mixes via standard stereo headphones.[53]

There is of course plenty of scope for future research. For now though, once again, at the most basic level such tools can be used in conjunction with techniques for multichannel recording and manipulation, but perhaps more specifically these practices to my mind, can easily be assimilated into regular record production and are therefore more viable to the average recordist.

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[48] Four variants of the 'Williams and Le Du' arrays & variants of the 'Johnston-Lam Technique'. Though there were also many hybrids.

[49] http://www.fluxhome.com/products/plug_ins/ircam_hear-v3

[50] From an ethical point of view with regards to costs and accessibility for the average studio engineer and facility, I deliberately on occasion used what one would arguably consider being entry-level microphones. Though this was by no means a major part of the work I was undertaking I felt that alongside the relatively cheap binaural encoding software provided by Ircam, and the fact that most modern DAWs have access to surround panners, that testing in such a manner may be a more inclusive form of research and in turn open up ideas for record production. After all, as I have already questioned, why should multichannel recording be stylistically inhibited?

[51] My interest in recording with arrays and the subsequent encoding to binaural is at this stage purely from a musical experience point of view. The Ircam encoder is simply a way to provide basic accessibility to multichannel reproduction and though I did conduct tests alongside my array recordings, at this juncture I do not wish to enter too deeply into what is arguably a whole other area of advanced research and study.

[52] Although, an AES paper published in 2011 by Braxton Boren &Agnieszka Roginska does suggest though that the Ircam database of HRTFs were the least favoured in the studies they conducted.

[53] Along side wanting to hear the results for myself, the binaural encoded versions served as a way in which Neil and myself could listen and discuss the progress of the tracks without having to access a full 5.1 reproduction system.

I also recognise that terms such as 'immersive' and 'envelopment' are very difficult to quantify, and as is pointed out:

"One problem with previous work on 'spaciousness' and 'envelopment' is that the two terms are difficult to define" (Griesinger ,1999, pg.1)

With regards to the series of tests I undertook and the reactions, commentaries and opinion I received as feedback, it can all be classed as highly subjective and at this juncture I have no intention of delving further into what once again could be seen as a whole other field of research.

Static & Non-Static Recordings – Test examples

In this instance 'static' pertains to:

1. Audio sources recorded whereby the source does not move during the recording process on a front facing sound stage.
2. Audio sources recorded whereby the source does not move during the recording process on a 360-degree sound stage.

In this instance 'Non-static' pertains to:

3. Movement of an audio source captured at the point of recording
4. Movement of an audio source via panning at the post stage

All audio test examples are within a green folder labeled 'TEST MATERIAL- Pro Tools listening session 5.1' on the USB stick submitted. Standard wav files for the binaurally encoded test versions are provided in a green folder labeled 'Binaural TEST examples using Ircam encoder & KU100" on the same USB storage device.

Within the Pro Tools Listening session for 5 channel playback or 5.1

1. Debussy :'La cathédrale engloutie' . An example of a Williams and Le Du configuration recording piano in Vestry Hall *(See Fig 7, pg.42, for photos of the array).*

2. Basic Source: basic test of an array used to record a static sample of drums in Vestry Hall drum booth. *(See Fig 1, pg.37, for a photo of the array).*

3. Mikes Sakelliou: An example of recording acoustic guitar in B2 using an 8 mic array based on the Johnston- Lam array *(See Fig 6, pg.41, for photos of the array).*

4. Simeon: Example of recording acoustic guitar and voice, with each overdub placed in different static positions around the array. *(See Fig 4, pg.39 & Fig 5, pg.40, for basic configuration and photos of the array).*

5. Simeon: Example of recording acoustic guitar and voice, whilst moving around the array. *(See Fig 4, pg.39 & Fig 5, pg.40, for basic configuration and photos of the array).*

6. Mikes: Example of recording acoustic guitar in B2 with fairly cheap pencil condensers using a variation of the Johnston Lam array. *(See Fig 6, pg.41, for photos of the array).*

7. Mikes Sakelliou: example of recording in B2, using one of the 8 mic arrays based on the Johnston- Lam array *(See Fig 6, pg.41, for photos of the array).*

8. Fiona Howe: example of piano recording in Vestry Hall, using a Williams and Le Du configuration. *(See Fig 1, pg.37, for a photo of the array).*

9. Whaletones: example of vocal sound sources moving around a Williams and Le Du configuration. *(See Fig 4, pg.39 & Fig 5, pg.40, for basic configuration and photos of the array).*

10. Teyr: Example of a static recording earlier in the year via an ambient array based on the 'Fukada Tree'.

Binaural Test Examples:
11. Mozart: Example of the binaurally encoded version of a standard INA-5 set up used to record a concert at St.Patricks Church in Wapping *(See Fig 2, pg.38 & Fig 7, pg.42, for configuration & photos of the array).*
12. Mikes Sakelliou: An example of a binaurally encoded version of 'Lady Wind' *(See Fig 1, pg.37 & Fig 3, pg.39, for photos of the array being set up and array configuration).*

13. White Noise Test: An example of binaurally encoded white noise that has been moved around to each individual speaker on a 5-channel reproduction system via the panner in Pro Tools. Used to simply
gauge what was happening with regards to localisation in the encoding process.
14. Whaletones: An example of how the 5-channel array recording listed above translated into headphones via binaural encoding. *(See Fig 4, pg.39 & Fig 5, pg.40, for basic configuration and photos of the array).*

15. Debussy: An example of a Williams and Le Du configuration recording piano in Vestry Hall that has been converted to binaural. *(See Fig 7, pg.42, for photos of the array).*

16. Mikes Sakelliou: Example of one of the Johnston- Lam variations encoded to binaural.

Not all of the tests I undertook have been listed above and below only a handful of the examinations and consequent findings are discussed.

Of the few presented and discussed, I feel that they had the most influence [54]with regards to selecting the final arrays and configurations for the recording of Circles.[55]

What follows is a summary, based off a portion of the most relevant findings.[56]

Debussy

For the Debussy recording I experimented with a variation based on the Williams and Le Du configuration highlighted in figure 4 (pg.????).
Rather than using the recommended cardioid polar response pattern, I decided to opt for 6 QTC-1 omni microphones.
At the rear I altered the angles so that both microphones were at 180-degrees from the centre of the array and spaced 50cm apart. In essence I was applying a simple spaced pair.
One extra microphone was placed facing directly upwards at the centre of the array to see if any extra height could be captured in the recording.[57]

Emilie Capulet in Vestry Hall performed the piece entitled 'La Cathédrale Engloutie', or 'The Sunken Cathedral'.
The recording was organised for research purposes by Dr.Simon Zargorski Thomas and Dr.Andrew Bourbon.

With their permission I was able to set up and record the piano, and though I would only be working with a static front facing sound stage, it was a great opportunity to hear a variation of one of the Williams and Le Du arrays within the same space that was going to be utilised for recording 'Circles'.
The array was set up in a fairly central position at head height within the hall. Though critical distance would not be a major factor in the recording of circles, on this occasion, one placed the array with the intention of a direct / ambient style recording, whereby the front facing triplet was used to capture more of the direct sound emanating from the piano.
The rear pair and centre QTC-1 facing upwards were simply placed to capture ambience.

It was also a great opportunity to use the ku100 dummy head and run a very basic listening test to compare the array through the Ircam encoder.[58]

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[54] Audio examples are provided.
[55] These recordings were not about the quality of the music and fidelity was not an issue, they are simply for testing purposes only. All Musicians have granted me permission to use extracts from their performances.
[56] There is no chronological order as to when the tests listed above were undertaken.
[57] As the photo shows in Figure 7, all microphones horizontally and vertically were positioned at 90-degree angles from one another.

[58] At this stage I was already aware that the front triplet of the array would very likely be utilised in the recording of 'Circles', as I had been impressed with results via previous testing. The conversion to binaural and ultimate series of listening tests, all be them highly unscientific, would at least give me a gauge of how well the finished, encoded recording may well stand up against the vastly more expensive ku100.
As aforementioned, if only briefly, I was intrigued to see if a cheaper and more accessible way to record with spatial audio in mind could be presented to other working engineers that possibly feel priced out of the market.

For the listening test, I decided to ask colleagues from the University to take part. Though only six replied I still decided to email out two small tests. The first involved 4 short excerpts from the Debussy recording.[59]

The six participants were asked to select which of the extracts were recorded via the dummy head and which via the array. They were also asked to say which ones they preferred and why.

Test Participant	1.Encoded Array with EQ	2.Dummy Head	3.Dummy Head with EQ	4.Encoded array
1	**X**	**X**	**X**	**X**
2	**X**	**X**	**C**	**C**
3	**X**	**X**	**X**	**X**
4	**X**	**X**	**X**	**X**
5	**C**	**X**	**X**	**X**
6	**C**	**C**	**C**	**C**

Table 1: Results from the Debussy comparison test. **X**= Incorrect Guess **C** = Correct Guess.[60]

As the table above highlights, only 1 in 6 got all the guesses correct[61] and only half made at least one correct guess. From a critical point of view, I appreciate that the use of EQ was to some degree a 'red herring' and could ultimately play tricks on the listener with regards to familiarity and possibly the ability to use localisation as a point of objective reference.[62]

However, it was the feedback from the participants that really caught my attention. Participant 3, an engineer that I respect and trust, suggested that the array sounded more 'centred'.

Though this particular participant guessed incorrectly on all of the 4 tracks I agreed with their comments. This suggestion of the encoded array presenting a solid 'centre' image appeared to be the case with all the encoded versions that had utilised this particular configuration [63]for the front triplet of the array.

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[59] All the recordings used were from the same point of the piece and lasted for the same amount of time. I kept one of the ku100 extracts and one of the encoded arrays extracts totally clean, whilst EQ was applied to another copy of both the dummy head and encoded array. The four extracts were then converted to AAC files, normalized and labelled as numbers 1 to 4.

[60] Please refer to 'Appendix A: Feedback From Listening Tests'

[61] On the second test where only two recordings of the concert in Wapping were compared, (a ku100 recording and an INA-5 recording encoded to binaural), only one of the participants that made the guess did so correctly. On that occasion though, only 4 of the 6 actually guessed, with three people in total stating that they could not tell the distance. This was perhaps down to the acoustics of the church as the diffuse and uncorrelated sound makes it harder to localize and define the quality of the sound.
[62] Putting critical analysis to one side for the moment, I would posit that further research into this area could yield some very interesting results.

[63] As previously mentioned all the mics were angled at 90-degree intervals.

Listening back via a standard ITU-775 speaker system previous arrays incorporating this configuration at the front of the array had impressed me with regards to stable imaging and the localisation of sources. [64]

The microphone at the top of the array, pointing upwards seemed to add very little with regards to a sense of height, though this is not to say that it did not offer anything at all. Once panned into the centre and boosted there was an added sense of immersion and the overall sound presented via all the mics, including the spaced pair at the rear, was solid and full.

Using omni microphones in such an array appeared to have little effect with regards to the overall effect on localisation. If anything, I would argue that the continuous coverage between segments was slightly coloured in sound at what Williams and Le Du (2000) refer to as the point of 'Critical Linking'.

Furthermore the use of a spaced pair angled at a full 180-degrees from the centre microphones seemed to lack the extra dimension with regards to phantom images at the sides. Though lateral imaging is known for its limitations via a 5-channel reproduction system, on this occasion there was a distinct spectral gap between the front and rear speakers.[65]

Mikes Sakelliou

Mikes, a fellow student off the MA record production course was the perfect choice to work with and test a variety of arrays as he wanted to record acoustic guitar parts for his own project.

 At this point I had conducted enough tests to be fairly certain that the front of my array would consist of the exact same configurations highlighted in figure 4. Though working with Mikes In both B2 and B3 studios at the university gave me the opportunity to rule out other more compact options whilst utilising a full 360-degree sound stage.

Variations loosely based on the 'Johnston-Lam' multichannel mic array[66] were utilised over a series of recordings. Although I followed in part the original configuration and the idea of closely spacing the mics from one another at angles of 72-degrees on the horizontal planar, [67] I decided to deviate from both the original spacing of the sphere's approximate diameter of 29cm and the suggested highly directional, 'hypercardioid' polar response pattern.

All the recording experiments conducted with either standard cardioid or omni patterns yielded some interesting results.

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[64] In essence the front three in the array had started to provide at least in part, the continuous coverage I was looking to attain over a 360-degree horizontal planar, or the nearest to such coverage, bearing in mind the limitations of such playback systems on offer with regards to lateral and rear source reproduction.

[65] That particular configuration for the rear mics was at that point discounted.
[66] As seen in figure 6
[67] Two other mics were added and positioned 'up' and 'down' at the centre of the array.

The sound was tight and again, very solid sounding. This was regardless of any interchannel crosstalk or colouration occurring due to the close proximity of the mics. The problem on these occasions was that the overall sound was too compact. When listening back to the various overdubs that I had asked Mikes to perform in various points in the live room around the arrays it became noticeable on playback that the parts were merging with very little space or depth noticeable when reproduced via 5-channels. This was especially noticeable after binaural conversion whereby localisation was practically non-existent.

However, it was still impressive how much relative space and detail was offered for such a small array set up in a small live room.[68]

With regards to the recording of 'Circles' such an array would not be ideal and would in practice capture any image of a said sound source, lacking spatial detail [69], which was something that the composer and I really wanted.[70]

Having tested the standard INA-5 (highlighted in figure 2) at the concert in Wapping, and from the knowledge I had gained via the other tests I had undertaken, which had ultimately led to a decision of which front triplet configuration I was going to use to record Neil. I decided to test another of the Williams and Le Du configurations.[71]

In the end, Mikes's main piece entitled 'Lady Wind'[72] was recorded in B3[73] using the configuration highlighted in figure 3 (pg.11). Both Mikes and I were exceedingly happy with the results, and the diffusors in B3 had aided in the outcome of the recording sounding spacious. This recording alone proved to the artist and myself, that such arrays could be utilised in smaller live rooms to record music outside of the classical domain and still provide the listener with a sense of spatial depth and the resultant feeling of 'immersion'.

Mikes summed the experiences up from an artist's perspective by stating:

"The sessions were revealing in many levels and thus very inspiring. The most obvious, but still surprising outcome (at least for me) was the effect that spatial manipulation had on the compositional aspect. The perceived spaces that were created altered the composition giving it fresh dimensions and provided stimulation as to the possibilities available by such manipulation of space. The combined performances sounded as a live performance of multiple guitarists (as opposed to overdubs), but still blended with each other in a way that was impossible to tell one part from the other.

---

[68] These compact arrays worked exceedingly well via stereo panning and playback. Mikes as the artist was impressed with how his guitar sounded and felt that even via 2-channel reproduction that such arrays captured and reproduced an image that sounded more like his guitar. This could again be looked at in future research. The correlation meters also suggested fairly healthy and stable phase coherency, on average above 0 heading towards a high +1.

[69] I had access to the soundfield microphone, one microphone capturing images from a centred, pinpoint location would be enough.

[70] Secondary to the desire for clarity and definition, at least in some of the movements.

[71] Ultimately this was just to be certain, but it also helped to validate my original proposal, whereby I stated that I would set out to test a variety of arrays.

[72] 5.1 mix is on the discs provided as a bonus track and the headphone version is on the USB stick in the folder labeled 'Binaural TEST examples using Ircam encoder & KU100' under 'Binaural bounces test folder' and then in the folder labelled 'Static'

[73] Basement 3 Studio, LCM.

This inspired me to think about the construction of parts in a new light". (Mikes Sakelliou, 2014)[74]

The array used to record 'Lady Wind' was not chosen to ultimately record 'Circles'[75] because of how it sounded in the headphones after binaural encoding. [76]

This decision with regards to headphones came about after a series of tests whereby the artists were deliberately asked to move around.

The Whaletones & Simeon

I thought it prudent to put the chosen array through its paces with regards to non-static sources due to the nature of the score I had received from Neil and with particular reference to previous pre-production meetings whereby a sense of movement was singled out. [77]

With regards to the Whaletones, they were kind enough to allow me to set up the array I had selected for recording Neil's new suite of music whilst they were using the space in Vestry Hall for a drum recording. The array was set at a similar point in the hall to where I had planned to record 'Circles' and as baffle boards were used to encircle one half of the room I could start to gauge how the array would sound in the space recording a 360 degree sound stage.

At the end of the day for the last 30 mins I was able to undertake the test recording and instructed the band members to walk around the array whilst singing an a cappella version of one of there songs.
I had conducted a similar test with a young artist called 'Simeon' a few weeks earlier, though on that occasion I had used the small drum booth.

Both tests highlighted that the chosen array was more effective in the larger space. Unlike the array that was used to record Mikes's 'Lady Wind' the 90-degree angled front facing triplet lacked definition with regards to localisation in the small live room, and on headphones it was hard to determine a smooth transition when Simeon moved between the front 3 mics. However this was not a problem with regards to recording in Vestry hall, whereby in fact the array provided a useful reach in terms of the coverage space. As the band moved around the array it was possible to focus on points and localise direction on the 5-channel surround speaker system and via the headphones after conversion.

The 40-degree spacing of the rear mics in the array worked well in both the hall and the drum booth, providing a decent sense of immersion and envelopment, whilst

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[74] Taken from an email received from Mikes, August 2014. Available via email communications, pg.22. Unpublished.
[75] Circles was recorded via the array highlighted in Figure 4.

[76] The chosen array once again appeared to provide the best, continuous 360-degree horizontal coverage compared to that used to record 'Lady Wind'. It was also noticeable that lateral imaging seemed less spectrally split via 5-channel speaker reproduction whilst also providing the best localisation with regards to both movement of a source and source placement whilst listening on headphones.

[77] Especially for Circles IV, as will become apparent.

allowing the listener to again focus on a point of sound and localise the said source on both headphones and on the speakers.

Using the information obtained via the test in the hall I was able to start planning the dimensions of the 'Circle' I was intending to map out on the floor of Vestry Hall for the recording sessions.

(Brocklesby, M, 2014)
Fig 1: (Left) Using a variation of a suggested array with cardioid DPA microphones to record an extract from a piano piece in Vestry Hall. (Top Right Onwards) Using one of the arrays exactly as recommended in Fig 3 used to record Mikes Sakelliou's track 'Lady Wind' (test recording on the Submission discs & USB storage device).
(Bottom Right) A variation of one of the Williams and Le Du arrays. In this example it was used to record a simple drum pattern in the drum booth at Vestry Hall. The array was used to test if any height could be added via the introduction of outer positioned, upward facing mics.
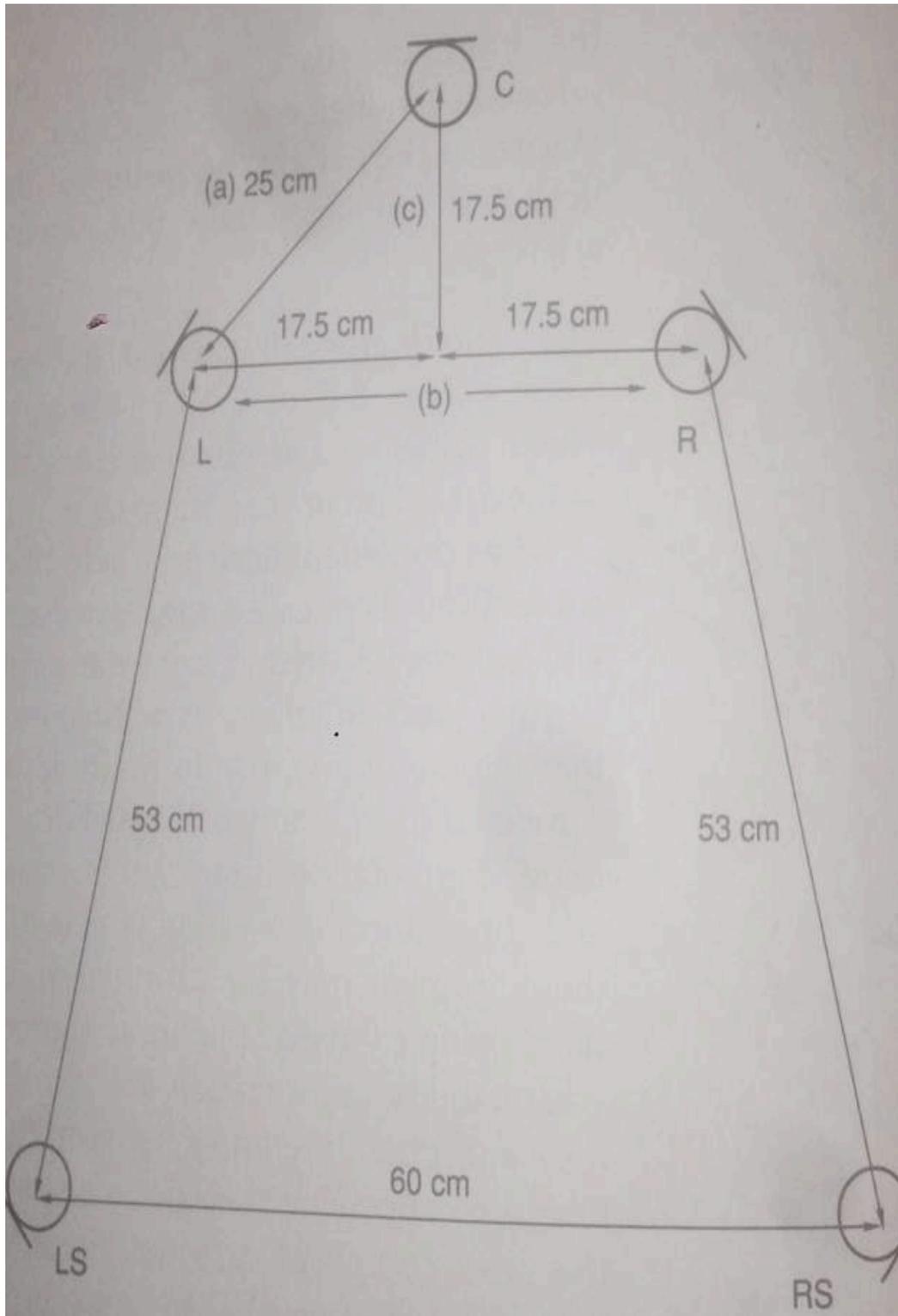
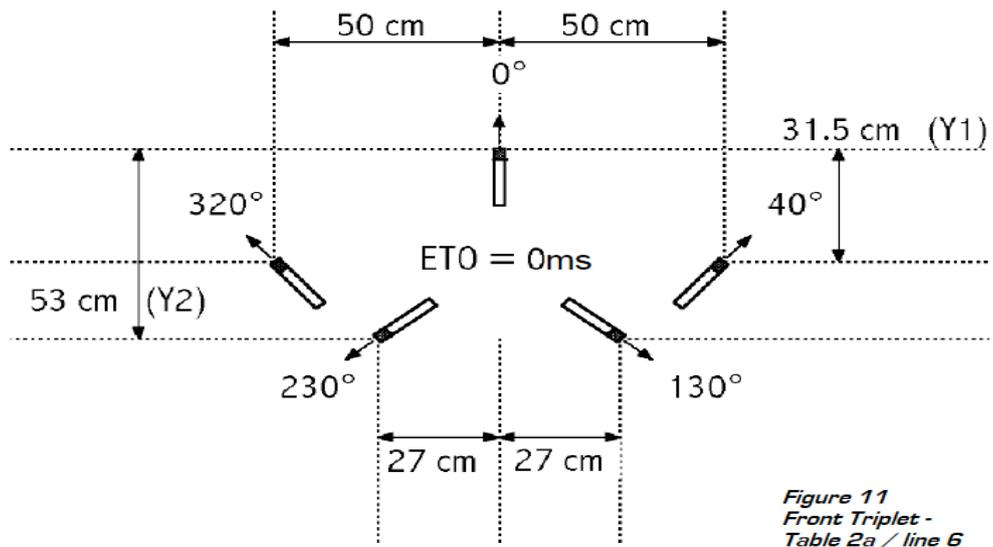*Fig 2: INA-5 Cardioid array configuration. (Rumsey, 2001, pg.194).*

Figure 11
Front Triplet -
Table 2a / line 6
Back Pair -
Table 2b / line 5

Fig 3: Multichannel Microphone Array Design (MMAD). (Williams & Le Du, 2003, pg.15)
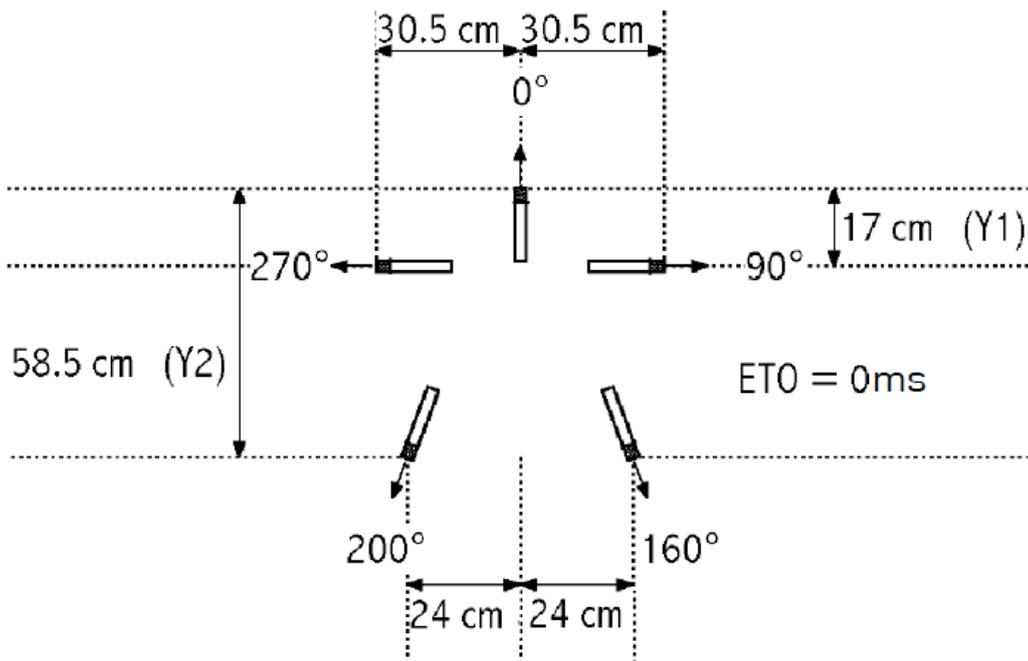

Fig 4: Multichannel Microphone Array Design (MMAD). (Williams & Le Du, 2003, pg.13)

(Brocklesby, M, 2014).
Fig 5: (left) A variation of the suggested array highlighted in fig 3.
(Top Right) a picture of the array set up to the specification laid out in Fig 3, with a KU100 dummy head and Soundfield V microphone.
(Bottom Left) Recording Simeon to test and compare localisation between the dummy head, and the signals recorded via the array and soundfield after binaural encoding.
(Bottom Right) Testing a slight variation of the array specified in fig 4. The array was used to record drums and then an a cappella version of a Whaletones track.

(Brocklesby, M, 2014).
Fig 6: (From Top Left) Variations of an array based on the Johnston-Lam multichannel Microphone Array, the original configuration of which is highlighted bottom right.[78]
The First 3 photos highlight the use of relatively inexpensive pencil condenser microphones with a cardioid polar response pattern. The last two photos show another variation of the array loosely based around the 72-degree angles of the Johnston-Lam array, however an extra mic was used to centre the rear and on these occasions 8 x QTC-1 omni microphones were used.

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[78] *The Microphone Book (Eargle, 2004, pg.261)*

(Brocklesby, M, 2014).
Fig 7: (Top Row) Standard INA-5 array used to record a concert in St. Patricks Church Wapping. 5 x C414s were utilised alongside the KU100 dummy head to compare binaural mixes from a static position after the array had been encoded. (Below) Recording of Debussy's 'La cathédrale engloutie'.
Variation of the array based on the configurations shown in figure 3.
The rear mics were set up as a simple AB spaced pair (30cm apart) and a centre mic was added pointing upwards at 90 degrees from all 5 horizontal microphones within the array. 6 x QTC1 omni mics were utilised. The KU100 dummy head was again used to centre the array and comparisons were made from a static front facing perspective regarding the sound stage after the array mics had been encoded to binaural via the 'Ircam Hear' plug-in.

References

Eargle, J. (2004) *The Microphone Book*, *Second Edition*. Focal Press.

Griesenger, D. (1999) *Objective Measures of Spaciousness and Envelopment. AES 16th International Conference on Spatial Sound Reproduction April 10-12th 1999* [Online] Available at:
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Williams, M. & Le Du, G. (2003) *Multichannel Sound Recording, Multichannel Microphone Array Design (MMAD).* Rycote Microphone Windshields Ltd. [Online] Available at: http://www.rycote.com/images/uploads/MMAD_-_Multichannel_Microphone_Array_Design.pdf. [Accessed Aug 2011]

Appendix A: Feedback From Listening Tests

Participant 3

Listening test - binaural vs surround:

#1+4: I believe these two tracks to be recorded with the KU100. Compared to track #2 & #3, the sound image is slightly more centered, i.e. a less wide spread.

#2+3: these two seem, to me, to possibly have a larger dynamic range. The lower mid range also sounds more controlled and detailed and upper mid less harsh.
The reverberation/reflections are perhaps slightly more detailed too and gives an overall fuller sound.

Concert tracks:
These sounds very identical to me, perhaps as the frequency spectrum and room's energy are more populated and utilised? An initial guess would be #1 is surround array and #2 dummy head.

Overall the differences and nuances between the recordings are quite small, which to me is a good thing! As the encoded surround array can compete and possibly beat a neumann developed binaural head. Not to mention its superior utilisation in other applications (surround).

Whether I'm right or not - good job, mate. Well done! And good luck with the last stage of the project, I hope it doesn't take all your energy and life out of you.
Speak soon, yeah?

Take care!

Participant 4

My guesses are probably wrong as I've never actually heard a dummy head recording before, but here they are:

Debussy 1 = dummy
Deb 2 = array
Deb 3 = array
Deb 4 = dummy

Baroque piece 1 = array, 2 = dummy

Not sure why, just the ones I think are dummy sound narrower and rounder (if that makes sense) and the array ones are more "widescreen" (flatter, bigger, not so circular/curved) I am aware that this is probably complete gibberish but I can't think of a better way of describing it. I hope it helps...

Participant 6

Debussy Recording
1 Encoded
2 KU100
3 KU100
4 Encoded
Concert Recording
1 KU100
2 Encoded

Let me know if you need me to go into reasons behind why I chose what I did and ill try and help you out where I can.

Feel free to send me the other stuff as well and I'll try and get to it when I can buddy.

Participant 5

Then at a guess:

1-3 your array
4 the head

   1 more over on the left hand side
        2 more bass more behind on the left... brighter, i duno maybe feels a little clearer then the others
        3 errr..... diffuse???
        4 above my head

        I have no idea which is which.... sorry, most of them seemed to be behind me on the left... not all enveloping SO i guess no 4 is the head....

        1 Concert Seems to be clearer, the violins seem better represented than in the second one which feels slightly muggy/bassier? (?!?)
        2 Concert

        regarding the head and your array still can't tell the difference ...

        Sorry I couldn't help much more....

Participant 1

Hey Mark, I had a listen and here is my impression

M4A-1 - I believe that this is a dummy head, the reason I believe so
is that when comparing it to M4A-2, I noticed much more presence in the low-end in
the 2nd recording, which I'm guessing could be due to the dummy heads
omnidirectional
and linear response in all of the frequencies (which I believe you used for the second
recording)

The same goes for M4A-3 and M4A-4. In which I believe you used surround
microphones on M4A-3 and
a dummy head on M4A-4.

As for the two concert recordings, would I be cheeky in determining that they are
exactly the same?
As after much deliberation, I find it difficult to hear any frequency/spatial difference
between the two. Hope this helps you, all the best with your project mate

Participant 2

1. Dummy

2. Surround

3. Dummy

4. Surround

1. Surround

2. Dummy
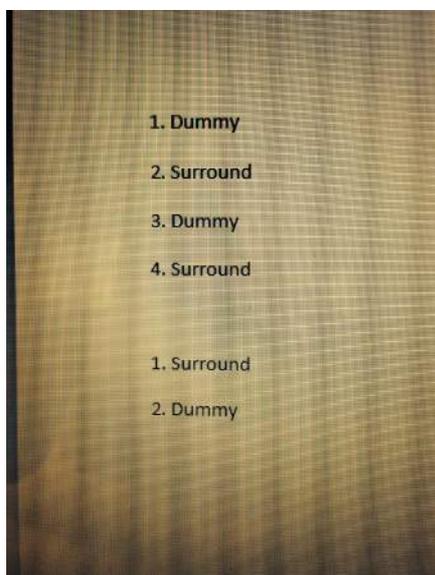
Appendix B: Musical Score for Circles

Circle 1

Neil Campbell

Circle 2

Circle 3

Circle 4
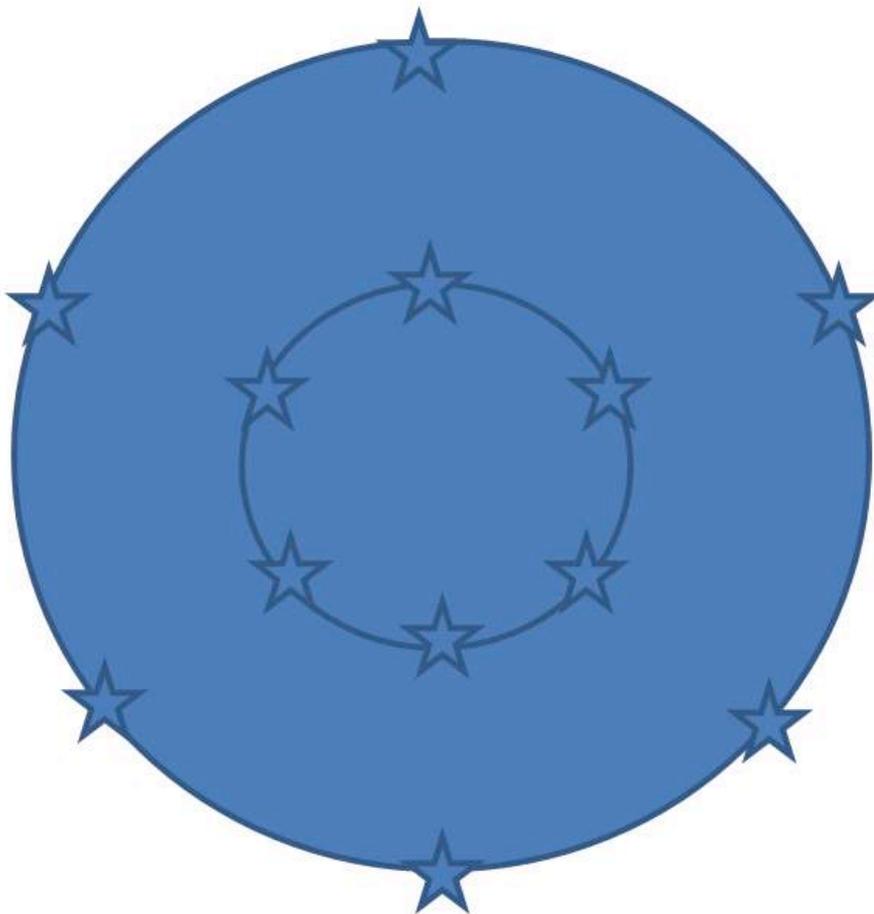
Appendix C: Diagram originally presented via the artist in pre-production highlighting the points at which the individual patterns in 'Circles' would be recorded.

Cheers
Neil

--
Neil Campbell, Liverpool Hope University Creative Campus, 17 Shaw Street, Liverpool L6 1HP. Tel: 07736 082978 or 0151 291 3419. www.thecapstonetheatre.com

Appendix D: Email with feedback from Mikes

Google

Gmail ▾

COMPOSE

Inbox (9)
Starred
Important
Sent Mail
Drafts (29)
▸ Circles

bank
Notes
More ▾

Ocado - £20 off at Ocado - Try us today for £20 off your first shop at Ocado.com.

feedback

Mark Brocklesby <markbrocklesbystudio@gmail.coı   3:39 PM (2 hours ago)
to Mikes ▾

Thanks mate, do I have your permission to quote you and to use the 5.1 recording as part of submission alongside Neil's work?

I would also like to use a few short excerpts of our test recording as part of my research folder

Sent from my iPhone

On 23 Aug 2014, at 18:19, Mikes Sakelliou <misaclat@gmail.com> wrote:

The sessions were revealing in many levels and thus very inspiring. The most obvious, but still surprising outcome (at least for me) was the effect that spatial manipulation had on the compositional aspect. The perceived spaces that were created altered the composition giving it fresh dimensions and provided stimulation as to the possibilities available by such manipulation of space. The movement of parts that was possible by pan automation had an even more striking effect: it was as if the track was different in each listening.

The combined performances sounded as a live performance of multiple guitarists (as opposed to overdubs), but still blended with each other in a way that was impossible to tell one part from the other. This inspired me to think about the construction of parts in a new light.

The sessions emphasised the importance and the potential of space as a compositional aspect and tool.

Mikes Sakelliou
misaclat@gmail.com
0781 861 5789
https://soundcloud.com/misaclat

On 19 Aug 2014, at 18:46, Mark Brocklesby wrote:

Search people...

◼ Chris Herstad Car...
○ Kaya Carney
○ Mike McCaffrey
Dave Evans
J. Lord Audio
Jane Hall
Jo Lord
Julian Manser
Kaya Carney
misaclat@gmail.c...